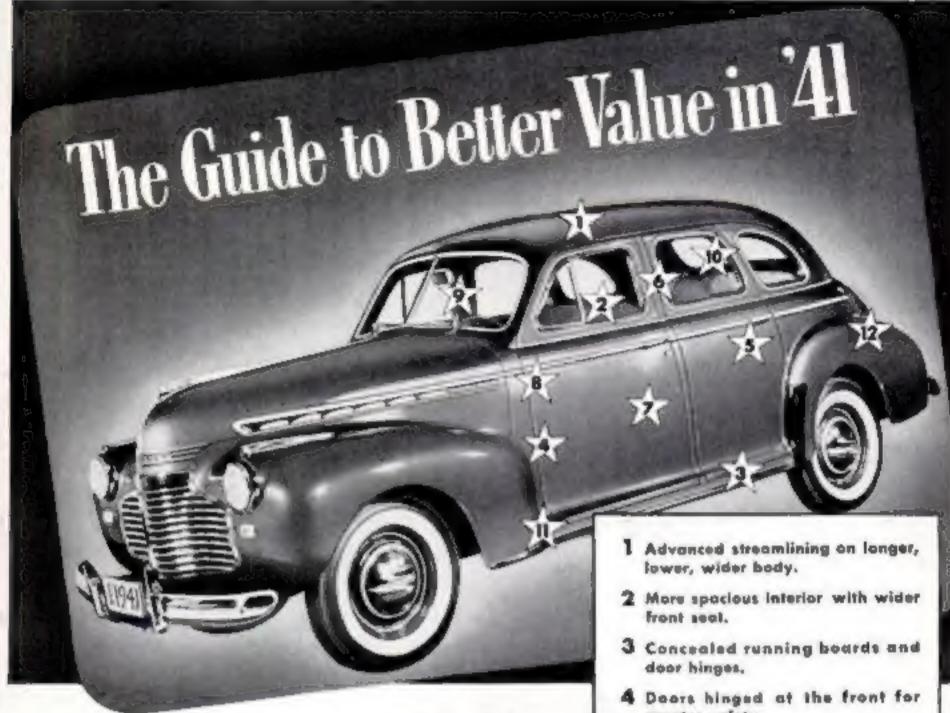


15¢ Three magazines in one automobiles · Home & Shop · MECHANICS





THERE'S no doubt that the 1941 Unisteel Turret Top ▲ Body by Fisher does more this year than ever before to set the new General Motors cars apart from the rest. Here Fisher craftsmen have truly scored one of automotive history's greatest achievements—by dressing a more spacious interior in the sleekest, fleetest lines a Body by Fisher ever had. Above and below you see the brilliant result as adapted to the new 1941 Chevrolet. And on the right are a few of the major new features this new Body by Fisher brings to 1941. General Motors cars in every price class. No wonder they're saying, "Body by Fisher is '41's guide to better value."

You Blody "CHEVROLET'S FIRST BECAUSE IT'S FINEST!" and you'll see one reason why in the breath-taking new Body by Fisher on the 1941 Chevrolet Special De Luxe Spect Sedan. It's a longer, lower, wider Unisteel Turret Top Body by Fisher than Chevrolet has ever had.



CHEVROLET - PONTIAC - OLDSMOBILE - BUICK - CADILLAC

greater safety.

5 Streamlined door handles harmonize with exterior.

• Dome light operates automatically as well as monutily.

7 Wider door entrances.

Door swing-stops hold doors open for more convenient entrance and exit.

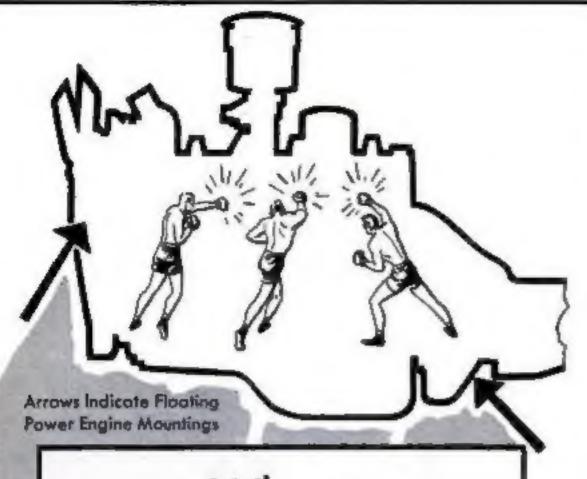
9 New flowback slant to windshield.

10 New double-curved back window.

11 Wider steel floor further strengthens Unisteel structure.

12 New steel reenforcements front and rear.





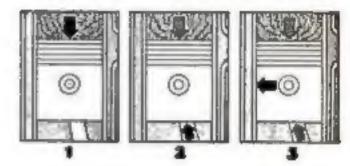
Why a FLOATING POWER ENGINE CAN "RIDE THE PUNCHES"

Scientific Principle Isolates Power Vibration Under the Hood of the New Plymouth

To PREVENT power vibration from shaking the frame and body, the engine of the 1941 Plymouth is mounted high in front and low at the rear on patented Floating Power engine mountings!

Thus suspended, the Plymouth engine rocks in balance—"rides the punches" of torque reaction . . . to keep them from reaching you!

WHY EVERY ENGINE VIBRATES



- Combustion forces piston downward.
- 2. Connecting rod resists downward piston movement from an angle.
- 3. Angle of resistance forces piston sideways—with the effect of a terrific punch against the side of the engine!



Water the silky smoothness of patented Floating Power engine mountings, Plymouth for 1941 brings you 19 big advancements!

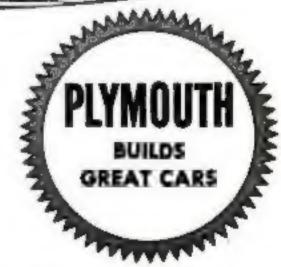
New High-Torque Performance and power-gearing make Plymouth a "powerhouse" to drive!

With its 117-inch wheelbase, Plymouth is impressively long and massive! And inside you'll find a sumptuous Fashion-Tone Interior! There are new High-Duty Engine Bearings, a new Oil Bath Air Cleaner, new Safety Rims on wheels, new Body Sealing!

See your nearby Plymouth dealer, and drive this big new beauty! PLYMOUTH DIVISION OF CHRYSLER CORPORATION.

Tune in Major Bowes, C. B. S., Thurs.

PLYMOUTH COMMERCIAL CARS!



POPULAR SCIENCE

FOUNDED 1872

MONTHLY

VOL. 128 NO. 1

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

CONTENTS for JANUARY, 1941

News

C-14 1041	42
Soldier 1941	47
Inventors Hunt "Secret Weapon"	68
Building Planes for Defense	72
Canada Rallies Her Cat Men	76
Plastics in the War	82
"Sweat + Brains + Training"	86
Scientific First Ascents	
America Raises Her Voice	98
Mechanized Zoo	104
Birth of a Bauble	110
The World's Biggest Navy	122

Automobiles

Bearings for Better Cars	128
Ideas for Car Owners	134
Road Tests Check Motor Fuels	137
Twelve Rules for Tire Health	138
Gus Wilson's Model Garage	140

Home and Workshop

Mastering Home Plumbing Repairs	144
Your House Needs a Check-up	152
Joggling Board Building Secrets	155
Workbenches for the Home Shop	160
Spiral Inlaying for a Lamp	176
Putting Your Skis in Shape	182
Using Your Camera on a Walk	194
Chaplin of Still Pictures	198

Departments

Our Readers Say	12
With the Inventors	
Ideas for Home Owners	16
Un-Natural History	103
Here's My Story	116
New Household Appliances	120
Book Reviews	
Radio Department	190



RALPH MORSE, 23-year-old camera veteran who made the pictures of army life on pages 47 to 53, snaps a whole series of photographs in the time it takes the average man to get focused. Hops a plane at the drop of a hat, and has photographed such famous people as President Roosevelt and the Duke and Duchess of Windsor. His chief interest, after film and flying, is good food,

EDITOR Charles McLandon MANAGING EDITOR . George H. Waits, Jr. HOME WORKSHOP EDITOR . Arthur Wakeling ASSOCIATES: Fred O. Newman, News; William Morris, Photography; Schuyler Van Duyne, Automobiles; Alden P. Armagnac, Edwin Teale, David M. Stearns, Group Editors; B. T. Richards, Copy Editor.

Published monthly at 353 Fourth Avenue, New York, N. T., by Popular Science Publishing Co., Inc., Godfrey Hammond, President and Treasurer, R. C. Wilson, Raymond J. Brown, Vice Presidents; F. W. Briggs, Secretary, Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional catry as sentond-class matter at Dayton, Ohio, Entered at second-class matter at the Post Office Department, Canada, Printed in U.S.A. Copyright, 1940, by Popular Selence Publishing Co., Inc. All rights reserved in the United States, Great Britain, and in all countries participating in the International Copyright Convention and the Pan American Copyright Convention, Single copy, 15 cents; Canada, 20 cents. Yearly subscriptions to United States and its possessions, \$1.50; Canada, \$2.00; foreign countries, excepting Canada, \$2.50. Subscribers must notify un of change of address four weeks in advance of the next publication date. Be sure to give both aid and new address.

SURPROE!

This young man has just got a big surprise!

He telephoned to congratulate a friend on getting a big promotion — and learned how little it costs to acquire modern training-for-success through the International Correspondence Schools!

You, too, will probably be surprised to discover that only a few dollars a month will pay for the sound, essential I. C. S. training you need to "get the jump" on job-competition. Compared to the cost of comparable training-courses (I. C. S. texts are being used by 24 State universities), I. C. S. courses in 400 business and technical subjects are amazingly inexpensive.

Mail this coupon - today - for complete information.



INTERNATIONAL CORRESPONDENCE SCHOOLS

1891 * 1941

BOX 7605-K, SCRANTON, PENNA.

Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course before which I have marked X:

Agriculture Air Braha Air Conditioning Architectural Drafting Architectural Drafting Acto Engine Tupa-up Auto Technician Aviation Botlermaking Bridge Engineering Building Estimating Chemistry Civil Engineering Contracting and Building Contracting and Building	TECHNICAL AND Cotton Manufacturing Diesel Engines Electrical Engineering Electrical Engineering Fire Bosses Foundry Work Fruit Growing Heating Heating Highway Engineering Mouse Planning Lisconotive Engineer Machinist Management of Inventions Management of Inventions Managing Mea at Work	INOUSTRIAL COURSES Mig. of Puls and Paper Marine Enginee Mechanical Drafting Mechanical Engineering Mine Foreman Navigation Fratternmaking Planting Planting Positry Farming Practical Telephone Public Works Engineering Radio Operating Radio Servicing Radio Servicing R. IL Section Foreman	R. R. Signalmen's Radriguration Sanitary Engineering Sheet Metal Work Steam Electric Steam Engines Steam Fitting Structural Drafting Structural Drafting Structural Engineering Surveying and Mapping Telegraph Engineering Testile Designing Toolmaking Webling, Electric and Gas Wooden Manufacturing
	BUSIN	ESS COURSES	
☐ Accounting ☐ Advertising ☐ Bookkeeping ☐ Business Currespondence ☐ Business Management ☐ Cartoning	Civil Service College Preparators Commercial Cost Accounting C. P. Accounting	First Year College Foremanship French Grade School High School Hustration Lettering Slow Cards	C Railway Postal Clerk Salesmanship Service Station Salesmanship Sign Lettering Spanish Traffic Management
	HOME ECO	NOMICS COURSES	
Advanced Dress O Foods and Cooke		e Charles and Designing	loom and Cafeteria Management, Catering
Name	A.	eAddress	

Canadian residents send coupen to International Currespondence Schools Canadian, Limited, Montreal, Canada British residents send coupon to I. C. S., 71 Kingmay, London, W. C. 2, England

Persent Position

Contents [CONTINUED]

Automobiles	Records Bring History to Life 91 Dude Gold Mine 102
Washinks Dan Yalinasa and	Subway Seats of Woven Plastic 108
Headlight-Beam Indicator	Movie Beasts Made to Order 109
Checking Gasoline Consumption 134	1. 11
Gloves Apply Wax or Polish 134	Craftwork
Homemade Oil Drain Pan	
Catching Dust from Honing 135	Soap Dispensers for Kitchen 175
Wall Extension-Cord Holder 135	Spiral Inlaying Decorates Lamp 176
Guard for Ventilator Pipe 135	Toy Farm Has Jig-Sawed Figures. 178
Floor Switch Tunes Car Radio 136	Windstorm-Design Weather Vane. 179
Air Power Mounts Tire	Coaster Set Turned on Lathe 180
Thermostat Controls Car Heater 136	Toy Wheels from Rolling Pins 180
	Leather Work Tooled with Pencil 180 Chinese Checkerboard of Plastics 181
Home and Farm	Chalese Checker boatte of Plastica 151
and the second s	Electrical
Metal Blocks for Building 16	
Weatherproof Glue Holds Anything. 16	Pliers Handle Strips Insulation 173
"Erosion Net" Protects Seeds 16	Knot Joins Flexible Lamp Cords. 173
Home Welding Outfit	Reel for Christmas-Tree Lights 174
Hand Tool Works Soft Metals 18	Testing a Small Cartridge Fuse 174
Fire-Resisting Lath Board 18	Using Plash-Light Cells Longer 174
Oil Burner for Small Homes 18	Invalid's Portable Call Signal 174
	Wire-Mesh Soldering-Iron Holder 174
Inventions	Miscellaneous
Dog Leash on Spring Reel 55	Market 1997 - 1 Por 1997 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
"Home-Cook" Restaurant Food \$5	Balsa Wood for Model Airplanes. 186
Radio Eye Guides Planes 56	Science Stunts You Can Perform. 188
Bottle Sprays Anti-Burn Solution 64	Shop Sayings of Old Bill 229
Electric Ears Hear Earth Secrets 90	Repairing Toy-Train Transformer. 230
Presser Does "Tailor-Made" Job 85	Rule Is Accurate Straightedge 230
Rubber Mannequins Are Flexible 119	11 41 . 41
"Electric" Paint Repels Barnacles., 119	New Shop Ideas
** *	Using a Metal-Turning Lathe 164
Military	Cutting Threads on Pipe Nipples 166
O	Angle Plate Aids in Boring., 167
What If C Army Incimic Tall 54	Adjustable Mount for Shop Motor. 168
What U.S. Army Insignia Tell 54	Tank Serves for Steaming Wood 169
Oxygen Masks for Army Fliers 59	Small, Powerful Screw Extractors. 169
Camouflaged Pigeons Bred for War 81	Polishing Irregular-Shaped Parts 169
Army's Hopper 92	
Truck Mounts Antiaircraft Gun 94	Electric-Arc Soldering Outfit 170
Blood Stored for War Wounded 118	Outdoors
N. L	
Facts and Ideas	Putting Your Skis in Shape 182
	Outdoor Wiring Accessories 183
Sells Double-Yolk Eggs 58	Bird Feeder Swings with Wind 184
Earth Views a New Comet 60	Snow Scooter Steered by Feet 184
Kings of Diamonds 62	Spearing Fish Through the Ice 185
Mickey Mouse Goes Classical 65	File Gives Skates Keen Edge 185
Tests Reveal Compatibility 85	Hinging Screen and Storm Doors., 185

IMPORTANT NOTICE: The contents of this magazine must not be reprinted without permission. The editors are not responsible for ansolicited contributions, and connect guaranter the return of each material or tumore against its loss. Contributions not secondaried by sufficient postage will not be returned. In prescring somerous slotter of one products of applied science. Popular Science Monthly does not underwrite the lineiness methods of the individuals or concerns producting them. To avoid liability for patent infringement, readers about investigate before making, using, or affecting for sale and of the devices, marking, or processes described; Popular Science Monthly takes no responsibility.

The use of Popular Science Monthly articles for stock-selling achesses is never authorized.



"Best Wishes for Your Happiness"

from your friends and neighbors in the telephone company. May the friendly spirit of the holidays carry through all of

1941... BELL TELEPHONE SYSTEM



A PRIZE POSSESSION in any home - and you can build it! Materials are polished pine and Tempered Presdwood *-a Masonite * wood-fibre hardboard -the board that won't warp, chip, split or crack when properly used. Tempered Presdwood makes anything you build permanent, able to stand up under the hardest kind of usage.

The top of this table is removable and can be used as a serving tray. Each of the shelves slides out for the same purpose. The table is 30 inches

high and moves on rubber casters,

Your nearby lumber dealer can supply you with Masonite Tempered Presdwood. And Masonite Corporation will send you free plans and working drawings, as well as a free sample of Tempered Presdwood. Just mail the coupon below.

* Trade-Mark Rep. U. S. Pot. Off. "Mountie" identifies all products marketed by Mountie Corporation,



THE WONDER WOOD OF A THOUSAND USES Sold by Lumber Declars Everywhere

COPTRIGHT 1940, MASONSTE CORPORATION

ESDWOOD

FREE PLANS AND SAMPLE MASONITE CORPORATION, Dept. PS-1 111 W. Washington St., Chicago, Ill. Please send me free plans of the emy-to-build Masonite Serving Tray and a free sample of Masonite Tempered Presdwood, Name. Address

Contents ECONTINUEDI

12/1 11

Protography	
Harold Harvey Gives Pointers 1	195
Type for Amateur Movie Titles 1	197
	198
The second secon	201
	202
	204 205
	205
The state of the s	206
	206
Rubber Pad Improves Printer 2	208
	208
	210
	10
	211
	211
	21
	22
	222
	222
Hook Holds Diffuser on Lamp 2	223
Holding Work Flat for Copying 2	223
42 4	
Radio	
Radio Built into Table Lamp I	90
	190
	90
	90
Heat-Radiating Tube Connector 1	91
	91
	91
	91
Radio for Summer or Winter 1	92
Shop Data File	
	49
	64
	65
	65
	73
The state of the s	81
The Handy Mon	
Simple Home Plumbing Repairs 1	44
	50
	52
Woodworking	
	55
THE PARTY OF THE P	

A Dressing Table and Bench...... 158

Workbenches for the Home Shop



Will You Pay the Price?

If you are normal, you want the comforts and luxuries which are the by-products of success—a home of your own—a new car—the leisure to read—the means to travel.

You want these things very much.

But—you are keen enough to perceive that experience and facility in handling routine work will never get them for you.

What, then, are you doing to gain that specialized experience—that trained ability—for which business firms are willing to pay real money?

During the past thirty-one years more than 1,000,000 men have found the answer to that question in home-study training under the LaSalie Problem Method.

Evening after evening, they have seated themselves, to all intents and purposes, at the desks of men in high-salaried positions, and have squarely faced the *problems* of those positions.

Evening after evening, they have been shown the principles involved in the solution of such problems—and how those principles are applied by highly successful business houses.

Evening after evening, they have tackled concrete problems, lifted bodily from business life, and under the direction of some of the ablest men in their respective fields have worked those problems out for themselves.

That they have been well rewarded for their foresight and their earnestness is shown by the fact that during only six months' time as many as 1,248 LaSalle members reported salary increases totaling \$1,399,507—an average increase per man of 89%.

Many men, knowing what home-study training under the LaSalle Problem Method can do for them,

nevertheless prefer to think that there's "nothing in it." That's the excuse they make for their futures.

If you—knowing these facts—are content to drift, you will not profit by reading further.

If on the other hand you have imagination enough to visualize your goal—to actually see yourself in a home of your own, enjoying the comforts and luxuries of life—if, in short, you are a man of purpose, the coupon below may shorten your journey to success by many years.

Note, please, that the coupon names different lines of training and that it will bring you full particulars of the training which appeals to you, together with a 48-page booklet discussing the opportunity and requirements of that field—all without obligation.

If you want success, and are willing to pay the price, ACT!

LaSalle Extension University

A Correspondence Institution

Debc: 109-K			CALIDARO
		the LaSalle plan	
a copy of "Ten]	'ears' Promotion	in One," all wit	hout obligation,
□ Business	Management	□ Law-Degre	e of LL.B.
☐ Modern	Salesmanship	☐ Commercia	
☐ Higher A	ccountancy	Credit and	Collection

- | Traffic Management | Correspondence | Modern Business Correspondence | Industrial Management | Modern Foremanship | Effective Speaking | C. P. A. Coaching
- ☐ Stenotypy—Stenography

Present Position

Address

THE 58,279 MISSING PIPE SMOKERS



Whose thumb prints are on the wrong packages of pipe tobacco!

A high percentage of exacting pipe smokers literally rave about BOND STREET once they try it. Our experience proves this.

We find 58,279 pipe-moking readers of this magazine are still "missing." Because they have yet to discover this delightfully different—truly aromatic blend?

BOND STREET contains a rare aromatic tobacco never before used in a popular priced mixture. It smokes clean—cool—rich as a custom blend. Leaves no tobacco odors in the room—even the ladies approve it!

Buy and try a tin-today!



A Product of Philip Morris

Coming Next Month—

ERIC SCHAAL, well-known photographer, and Hickman Powell, ace reporter, have joined forces to bring POPULAR SCIENCE readers the latest news in the glue industry. In "Plastic Glue for Everybody," they tell the dramatic story of a brand-new development from the synthetic chemist's laboratory—a development that now places at the disposal of the home owner and the home craftsman a revolutionary glue formerly available only to manufacturers.

FAST FREIGHTS OF THE HIGHWAY cover American roads today, carrying cargoes over a new transportation network that spreads from coast to coast. To get the inside story of the men who drive these giant trucks, we put Ralph Morse and his faithful camera into the cab of a 20-ton tractor-trailer unit for a night trip from New York to Baltimore. In a seven-page picture story, "Big Wheels Rolling," he takes you for a truck ride you'll never forget.

ONCE IN A LIFETIME of driving, the average motorist might find himself in the sort of driving predicament Jimmie Lynch's Death Drivers put themselves into a dozen times a day. Yet Jimmie and other stunt drivers lead notoriously safe lives. Because they do, we asked Jimmie to tell you what to do to recover control of your car when that once-in-a-lifetime close call does occur. Look for his answers next month in "Jimmie Lynch Gives Seven Rules for Safety."

ONLY A FEW YEARS AGO, Dmitri Kessel didn't know any more about taking pictures than the average man, but he thought photography might be an interesting and remunerative line of work. So, as his first step, he took a course in the best photographic school he could find. From that time on, he has gone straight up until now he is one of the top-ranking industrial photographers. His success story is told by John H. Walker, city editor of the New York newspaper PM, in an article, "Dramatising Industrial Photography."

FIREPLACES are often cranky affairs that give out much amoke and little heat, but most of them can be made to burn properly. What tests to make, how to remedy any defects, the right way to build a fire, and scores of hints are contained in an article, "Fireplace Doctor Tells How to Cure Chimney Ills." It is based upon the experience of Frederic N. Whitley, of Brooklyn, N. Y., whose family has specialized in fireplaces for four generations.

A

rohat will you be doing





MIAN, there's no sense in drifting along at the same old dull, drab job! You've got one life — that's all. What you make of it is your business — but if you want to make a success of it, it's time to get going!

Listen. Some of the biggest men in this country were in your shoes once. But they knew one thing! They knew that it takes training—TRAINING—to succeed in this

world! And they got that training through the I. C. S.!

100,000 ambitious men are enrolled with the International Correspondence Schools right now. They're going places! They're getting sound, essential TRAINING by a method based on up-to-date textbooks, personal instruction, and sound vocational guidance. Here's the coupon they mailed!

INTERNATIONAL CORRESPONDENCE SCHOOLS BELEBRATE SO YEARS OF BERVICE TO AMBITIOUS AMERICANS

1891 * 194

	BOX 7666-K, 3	CRANTON, PENNA.	·	
		i me a copy of your boo ourse <i>before</i> which I be		id 🜟
		INDUSTRIAL COURSES		
Agriculture D Air Brake Air Conditioning Archivesteral Practing Archivesteral Practing Archivester Auto Engine Tone-up Auto Technician Aviation (J Bodecmaking Building Engineering Building Engineering Chemistry Civil Fouriered Cond Mining Contracting and Huilding	E From Growing Renting Hear Treatment of Metals Highway I no newtong Hughway I no newtong Hughway I no newtong Hughway I no newtong Localitative Laginoer Machiner Mac		R. R. Section Foreman R. R. Signalmen a D. C. Sanitary Engineering Short Metal Work Steam Electric DS: Steam Electric DS: Structural Drafting Structural Engineering Structural Engineering Translate Designing Translate Designing Tooltmaking Worldon Manufacturing Woolen Manufacturing	inam Englow E
		ESS COURSES		
Accounting Advertising Backkeeping Buildon Correspondance Buildon Management Cartooning Civil Service	Coffee Properties Commercial Control Accounting C P Accounting D Plant Year College	C Foremanish Conde School C High School C Lettering Show Carrie C Managing Men at Work	☐ Railway Postal Clerk ☐ Sales makes by ☐ Secretarial ☐ Righ Lettering ☐ Traffic Management	D Photoles
		NOMICS COURSES		
Advanced Drum Discoulant Could	making [] Home Drumps ery [] Profusional D	king remarking and Dungsing	Tag Room and Cafeteria Management, Calering	
амения на на на на		lee		tut en F *n ha eventurisisten
lty	State	Present Pontion		

ONSHRINKABLE WOOL may soon become more than a house-wives' dream. Two years of research in treating wool yarn with a bromine process have convinced the Warner Chemical Co., of New York, that it has found a method of preventing shrinking which does not affect the wool's warmth, softness, or dyeability. The process involves no change in textile manufacturing methods, and adds only five percent to the cost of a finished article. A treated pair of wool socks, used for eighteen months in a hospital, have been washed almost every week and haven't shrunk yet.

Moura Beach

WIND-DRIVEN GENERATORS with giant vanes like airplane wings will be installed next spring in an experimental 1,000-kilowatt vento-electric station in the Green Mountains near Rutland, Vt. Using a Smith-Putnam wind turbine developed by the S. Morgan Smith Company, of York, Pa., the station is expected to produce power as cheaply as any method now available. Accurate speed regulation of the generators has been a major problem in this form of power production in the past, but engineers believe they have solved it at last. Installations of this type would be used with other sources of power, such as hydroelectric plants, which could take over the load in periods of calm.

ELECTRIC POWER WAS TRANSMITTED by wireless in a recent demonstration at the Westinghouse Lamp Research Laboratories, Bloomfield, N. J. Flash-light bulbs with copper antennae were lighted by high-frequency waves from a new type of generator, a "Klystron," several yards away. The generator and its uses are still experimental.

TILKY DISEASE," a bacteria with which Japanese-beetle grubs sow the seeds of their own destruction, is being tested by scientists at the Department of Agriculture's research station at Moorestown, N. J., as a new means of combating the beetles. Grubs intected with the bacteria turn milky white and disintegrate, leaving only a tiny heap of germs, which are picked up by the next grubs to come along. Birds help in distributing the bacteria by carrying infected grubs from one area to another. The disease does not affect birds, animals, human beings, or plant life.

ARGE AMOUNTS OF VITAMIN D and calcium given to patients with broken bones, in accordance with current practice, may actually retard or prevent healing. Dr. Edward L. Compere, of Chicago, reported to the American College of Surgeons recently that experiments with rats indicated that patients with broken bones would recover more quickly if fed only an adequate diet. This rule does not apply to infants, Dr. Compere said, because children require extra Vitamin D and calcium to prevent rickets. Older children and adults can get all the Vitamin D they need from their diets, he said.



I will Train You at Home in Spare Time for a GOOD JOB IN RADIO

E BMITH President Mat unal Rad o Institute Established 25 Years

If you can't see a future in your present job feel you'll never make much more money you re in a censons, faid, subject to lay offs, IT & TIME NOW to investigate Radio. Trained Hadio Technicians make good muney and you don't have to give up your present. job or leave home to learn Radio. I train you At bome nights in your space time.

Why Many Radio Technicians Make \$30, \$40, \$50 a Week

broadcasting stations employ operators. technicians. Radio manufacturers amploy test technicians. Radio manufacturers employ test ore. Impertors, servicemen in good law jobs. Radio Jobbers, dealers, employ installation and servicemen. Many Radio Technicians upon their own Radio tales and repair businesses and make \$30, \$40, \$30 a week. Others bold their regular jobs and make \$5 to \$10 a week faing Radios in space time Automobile, Police. Aviation, Commercial Radio Loudspeaker Systems, Electronic Devices are other faith affecting opportunities for which N. R. L. Solds offering opportunities for which N gives the required knowledge of Badia. Television promises to open good jobs seen.

Many Make \$5 to \$10a Week Extra in Spare Time While Learning

The day you enroll, I start sending you Extra Money Job Sherts—start showing you bow to do Badlo repair jobs. Throughout your Course

I send plant and directions which have helped round make \$5 to \$10 a week in spare time ment to conduct experiments and but dichrofts. This 50-50 training method makes learning AL Nome interesting, functional processes, PROFESSIONAL ALL-WAVE, ALL-PURPOSE SET SERVICING INSTRUMENT to help you make money fixing Radios while learning and equip you for full time work after you graduate.

Wheel Buck SMS on the Stee Annal

bo

shows more than 100 letters from men I have trained to ling what they are duling and earn-ing Read my money back agreement. MAIL ing Read my money park agreement COI PON in an entelope of paste on a penny posteard—NOW!

J. E. SMITH, President Dept. 1AP3 National Badlo Institute Washington, D. C.

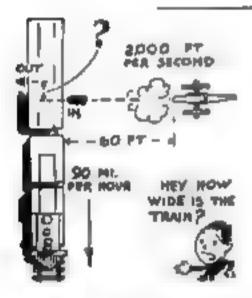
Find Out What Radio And Television Offer You t Teday! Mail the corpon for my 64-page ob. Rich Rewards in Radio" It points (Radio) space time and full time appearance and those coming in Television tells out my Course in Radio and Television, J. E. SMITH President, Dept. 1AP3 National Radio Institute, Washington, B. C. Mail me FREE, without obligation, your 64 p. Rewards in Radio. (No seignman will (a.)	TAKE MY TOO LATE. TAKE MY TIP AND MAIL THAT COUPON TO N.R.I. TONIGHT N.R.I. TONIGHT N.R. I. TO
As	
Nier-	TH RADIG
Address	1 2 C C
City State	



Cameraman Catches Kids Having Fun at the Zoo

Your readers may be interested to know that the youthful models who posed for the pictures in the "Mechanized Zoo" story (page 104) are my son, Peter William Morris, aged 2, and Joy Krumm, 4. Peter William began his photographic career by posing at the New York World's Fair with William Allen White, who called him "the most photogenic baby in the world." Peter William and Joy also posed for a picture geries "Vest-Pocket Romance at the Fair."-W. M., Elmhurst, Long Island, N. Y.





The Cannon-Ball Express

Ir a cannon is fired at right angles to a train moving 90 mp.h., from a distance of 60 feet, with the velocity of the projectile 2,000 feet per second, what will be the distance from the hole made in the near side of the train to the hole made in the far side"—H. H., New York City.

for National Defense!

Mobilize the Home Workshops

IN THESE days when all the resources of our country are being mobilized for defense, have you thought of the possibilities in the home workshops? There are thousands of metal lathes that could be used as accurate production machines. Homeworkship groups could be assigned quantities of production parts to turn out. Surely some use should be made of this big child of American leisure,-R. H. B., Boothwyn, Pa.

A Stamp Licked Nicaragua's Canal

IN ANSWER to E S. T., of Washington, D.C., who asks what became of the Nicaragua Canal: Before the Panama Canal was built, those who opposed the Nicaragua route said that the canal would be in constant danger of destruction by vol-



canic eruptions. When it came to a vote in Congress, a French engineer sent every member of the Senate a letter bearing a Nicaragua stamp which showed a smoking volcano. The Panama route was chosen by a margin of four votes. I am a stamp collector and would like a stamp department in P S. M .-- A. S. C., Uniontown, Ohio.







ENT and Market Invent on How to Obtain PA

WE GIVE SPECIAL ATTENTION MILITARY INVENTIONS

This to the essential nature of interplants with the philite inn-bidense of tested in the Northead Sickense we are given aperial plication, to such institute, a ca-in the philips of basis the la highest of proper averages to the proper subback they

If you have invented something if you gre interested in Inventing something you need Patent our new to-page Guide' that gives the entire Story of Patents It tells you for the first time about new planes of tarentian how oth ers succeeded how the patent laws protect you, how to murket your invention, where to obtain finances, how to form a company, partnership, or

arrange for royalties from your invention's sale.

Be Sure To Protect Your Rights

The U.S. A is the greatest open market for new inventions in the world. Here commercial striving is so keen that the unprotected invention, if It has public acceptance is quick ly "eyed" and may become the prey of eager competition. Worthwille manufacturers will not bear the production costs and sales expense of promoting a new investion un-protected by patent. A good, strong patent not only opens the road to marketing your invention but closes it to would be chisclers who may seek to reap the rewards of your creative efforts.

Free Form For Recording Invention

When you send for our FREE "Patent Guide." we include. also Free, our specially prepared Record of Invention

blank on which you can quickly make and date a sketch and description of your invention. This 'disclosure' as the alled, may be absolutely invaluable as evidence for you, should your rights ever be contested. Be sure to get it and use it.

Let Us Help You With Your Patent

During the past twenty years we have helped great numbers of inventors secure their U.S. Patents. We know the pitfalls and how to avoid them, We buve trained, experienced patent droftsmen and registered patent attorneys ready to serve you stul each one, when he undertakes to

hardle your case, realizes that be is personally responsible to contribute the fullest individual effort possible

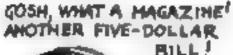


Know exactly what you should (N) The expectation is \$ 10 to hill name he done every step at the war how the Patent has crotes to you what we, as Registered Patent Atterners can do fer you Mall the above courses NIW for our 48 age. Patent builder and "Record of Invention" Furm



1A2 ADAMS BUILDING, WASHINGTON, D. C.

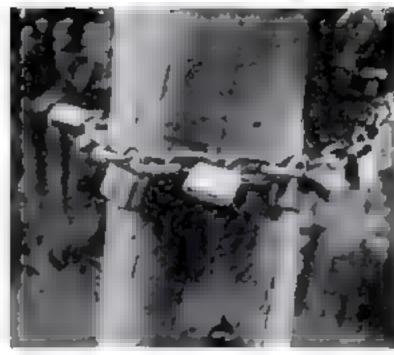






It's Money in His Pocket To Read P. S. M.

It costs me less than nothing to be a subscriber to Popular Science Monthly. I pay \$1.50 a year and get thousands of ideas in return, besides lots of interesting reading matter. You paid me, this last year, \$11 for two ideas. I hope to get more out of you this year.—W. P. S., Pasadena, Calif



Chain of Padlocks Tells Who Left the Gate Open

Propin who leave locked gates open are a nuisance. An association owning hundreds of acres in the Adirondacks has found a way to control them. It owns a private log bridge across a lake, which is crossed by a public trail. Hikers are welcome, but the only cars permitted to cross the bridge are those of a few camp owners and the trucks of the firs wardens. Nine padlocks form links in the chain that closes the log gate. Each padlock has its own key, and each key its owner. If the gate is found open, the unlocked padlock will immediately identify the guilty non-closer.—D. V. A., Saratoga Springs, N. Y.

Economical Boat Builder Shaves a Nickel off Our Estimated Cost

HERE is a snap of the Plywood Dinghy described in your magazine. It weighs eighty pounds and cost \$19.95 to build, with a few screws, etc., left over. This is the second boat I have made from your plans, the first being the 17-foot Cabin Cruiser of plywood con-

struction. I would like to express my appreciation for the clearness of the plans and presentation.—E. C., Dorchester, Mass.

Good work on E C's part, but he should have spent five cents more. Our cost estimate was \$20, not \$19.95!—Ed.

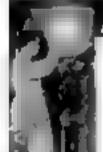






A study by but practical recolator Navy this and house short in the house of the Eight columns havy and speedy up attend I rections the uded 10-DAY TRIAL—Money shipment. Only 11 49.

FIGELITY PRODUCTS CO., Dept. 1P3, 277 Breadway, New York, K.Y.



Both Electric Are and Aretylene by practical Shop-Plan method in a few short weeks. No text books, You learn by doing Finest equipment, Low tul-tion, Pay-After-Graduation-Plan. Also, courses in Auto Mechanics. Collision Work, Metal Finishing, etc. Il us rated bt-erature from Write today.

CATALOG

cut to a keeper islad believ The Thinking Alphabet is apeach, stronger personality quarker advancement Free Mind Power lest and Book et rinent higher earpings.

Self Advancement Institute, 99C Fern St... Philadelphia.



Not Expensive to Learn SCIENTIFIC CRIME DETECTION

The Steady Pay Profession Good Times—or Bad

"I will teach you Finger Print Identification - Firearms Indentification—Police Pho. tography—and Secret Service!" That's what I told the en who now he do the found jobs I sted in the colnunattherabt, Glyom a chance and I'll train YOU to fill an important position in the fascinating field of scientific in a detection





ITRAINED THE MEN WHO THEN GOT THESE BIG JOBS

GET IN NOW!

Rut don't be misled. Scientific crime detection is not simple. It a a science-a real science, which requires very special training. I teach you this science so that you should be competent to do the work of a thoroughly trained emplayer in a hureau of identification, for the rest of your life. I give you comething nobody can ever take from you.

LOOK AT THE RECORD!

47% of ALL Identification Bureams in the United States are headed by our students and graduates. They have regular jubs salarles often collect reward money - and many of these men knew absolutely nothing about this work before they began their training with me.

OF CRIME

This book is full of exciting information on selen ife crime describe. It will show YOU how YOU have YOU as a cust so for you shouldn't even think of it, can get started without delay. Don't wait, Clip coupon . . . send tt NOW1 SEATTLE,

Hera are a few of the 600 bureaus headed by our students and gradwates.

STATE BUREAU DELAWARE

STATE BUREAU FLORIDA

STATE BUREAU 0F MAINE

STATE BUREAU OF MICHIGAN

STATE BUREAU OF NEW MEXICO

STATE BUREAU RHODE ISLAND

STATE BUREAU O SOUTH CAROLINA OF

STATE BUREAU TEXAS

STATE BUREAU UTAH

LINCOLN, NEBRASKA CONCORD, N. H. ALBANY, N Y TRENTON, N. J. CANTON, OHIO

TULSA, OKLA. MOBILE, ALA. PHOENIX, ARIZ. LOS ANGELES, CALIF.

INSTITUTE OF	APPLIED	SCIENCE
1920 Sunmyside Ave.	Dept. 1361	Chicago, III.

INSTITUTE OF APPLIED SCIENT 3920 Sunnyside Ave., Devi 131	61, Chicago
Gentlement Without any obligate Blue Book of Crime," and comploying your graduates, togeth Lasy Terms Offer, (Literature stating their age.)	uplete list of 800 bureaus em-
Num*	
Address	
	Age

Helpful Inventions for the Home Owner



How metal blocks can be used with other building materials

Metal Building Blocks

Resist Fire, Vermin

"Building Blocks" stamped out of noncorrosive steel provide a speedy and economical way of constructing small dwellings, apartment houses, and office buildings alike. They weigh only two pounds apiece, compared to fifty pounds for concrete blocks of the same standard size, and are declared to sliminate waste of material, According to the maker, they are proof against fire and vermin. In using this method of construction, the metal units are stacked one on top of another, and permanently fixed in place with locks of spring wire. The illustration at left shows how they may be employed in conjunction with other building materials. For some purposes they may be used alone. Seven years' experience in tearing down houses and finding rotten stude and sills suggested the idea to the inventor, Augustus Frati.

Special Glue Holds Anything —It's Weatherproof, Too

RESISTANT to weather and insoluble in water, a versatile glue of special composition may be applied to virtually any similar or dissimilar materials. Two pieces of wood glued together with it will never warp, it is said. The quick-drying adhesive may be used hot or cold, and a film of only tissue thickness is sufficient.



Laid over seeded soil, twine much holds seed in place



Spreading glue on wood. A tissue-thin film does it

"Erosion Net" Keeps Seed from Washing off Lawn

HEAVY rains cannot wash away freshly planted grass seed from slopes protected with "erosion nets," successfully introduced last fall. Laid over the soil, a quarter-inch mesh of rot-resisting paper twine forms innumerable tiny dams, holding the seed in place without cutting off beneficial sunlight. When the grass reaches a height of two and a half inches, the net may be removed. Designed especially for lawns and terraces, it is an adaptation of an idea used by the U.S. Department of Agriculture.



LINCOLN GOVERN. MENT APPROVED SCHOOL of AVIATION wants to wh tredate get in that why N W made, 12 pos f s as Commercial Pitots, 15 Airnance Mechanics, as Arrplane Factory Mechanics, as Aeronautical Engineers. TRAINED MEN- HIG PAT A 11 b w b 10 m 115 WR TE TODAY for **Eumple le Information** LINCOLN AERONAUTICAL

DISTITUTE 431 Aircraft Bldg.,

Lincoln, Nobranka.

IARGAIN CATALOG

23,668 books of all publishers hat
ad in our toth Annual Bargain Catalog of 120 pages, Old-time
lavorites—atest best sellers Heferance, Piction, Juvenile,
History Scientific et Supplying schools, colleges, libraries and
thousands of individual customers. Send postcard today for our
new 1941 catalog, "Hargains in Books."

THE BOOK SUPPLY COMPANY, DEPT. 143 564-366 West Monroe St.

Practical tested training, Bucked by 35 years experience Course includes Auto Mechanics, Diesel Service and Operation, Diesel Power Generation, Machine Shop Practice, Auto Electrics, etc. Flexible plan to meet specific needs of those with or without jobs Oldest, largest trade school in West qualifies you and belps you get a good pay job. Transportation allowed to L. A. Earn room and board while learning. Request Pres Catalog.

Re not in Golf 22 Days. Why breed for small conflicted when maney no.

All the aquests you can ship, every day to year? NEW HOOK in how presults yet and accounts of a remark of a remark, not for FREE 1912 pagety system on the first of REE FARM 600 N ST MELROLE MASS



Tool & Die Making Body & Fender Repair, 17th Pear Unimited training period without charge Wri a today for free circular watering School of Trailes 1406 W Fort Original

FREE CIRCULAR

Purtial Payment Of the Property of the State of the Payment of the

Clectroplates



New, patented invention makes possible big earnings AT HOME. Replate autoparty word articles in nomes, scores of or w Co t of meta with stroke of brist First mire the ou. k German Good, store that Cador that e his restrictions for a shed that the complete the freedy for use to store the complete the ricony \$2 to \$5 and hor no cet mine. ness Small investment at its you in bus his Steady repeat. Moreone can pay for the a week Send TO() At for FREE SAMELE and Justrated BOX/KI I Thow you can be a leasure from the great of YOLR AND a leasure from the great of YOLR AND A control of the great o built u ion satisfied customers. Act at once!

WARNER ELECTRIC COMPANY 360 N. Michigan Ave., Chicago, Itl., Dept. 2-16

ACCOUNTANCY

One of America's best paying professions



These Are

OPPORTUNITY DAYS for the Trained ACCOUNTANTI

WITH new state and federal legalation requiring more accurate accounting from businesses than ever before, the trained accountant is certainly a man to be envied. Much in demand, member of "America's best-paid profession," an important figure in affairs, he is one of the most influential and securery indi-

viduals in the whole business scheme?
His is a profession YOU may be considering at this moment. If so, don't fail stee to consider critically how, when, and from whom you will secure your Higher Accountancy training. Consider particularly Laballe's record of more than 500,000 Accountancytrained men and women during the past thirty years -a record unsurpassed by any other educational insti-

Remember, too, how numerous are the available accountancy schools and courses in the country Yet, despite this fact, approximately one-tenth of all C.P.A.'s have been student members of LaSalle

As to the training startf, you will find it absolutely complete; from Elements through to Accounting Systems, and a choice of twelve post-graduate elec-tives, including C. P. A. Coaching that qualifies you thoroughly

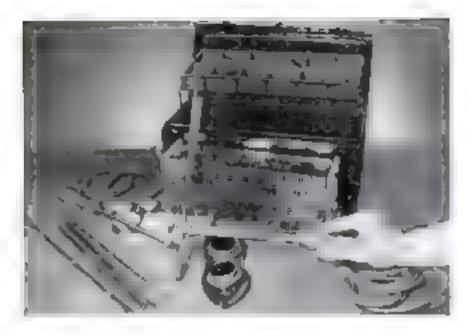
Spare time study does it n'll No interference with your present work and a careful analysis of thousands of student histories reveals that some have realized in increased later earnings, as high as \$50 returns on every hour devoted to such study

If you are actually in earnint—are willing to work devotedly for your future success, look into this subject carefully, thoughtfully, and from every angle. Full information and a 48 page survey of this opportunity field will be sent you on request.

Sign and mail coupon for complete details

LASALLE EXTENSION UNIVERSITY

A Corresponder	ice institution
Dept. 183-HR (Chicago
Kindly tell are more about the opportunities in Accounting a your training can help me gran Amount of the first your boo. "Accountancy, the Profession Pays." Higher Accountance Other LaSalle Opportunities.	p them kiet on That
If more interested in one of the lodicated below, check and man	Gelde Joow
E Business Management Modern Salesmanship Claw Degree of LL. B. Commercial Law	C. P A Cosching Traffic Management Stenotypy
Name	
Paramet Parameter	



Outfit for Home Welding Has Everything you Need

To AID the handy man who makes his own home repairs, a compact kit provides everything needed for electric welding and brazing. Besides a power unit to be plugged into any socket, A.C. or D.C., it includes a holder, two carbons, rods, and fluxes.

Versatile Electric Hand Tool Works Soft Metals, Leather

Making candlesticks, ash trays, and other artistic pieces becomes easy for the owner of a lightweight electric hand tool. Its reciprocating plunger takes interchangeable heads for hammering, filing, chasing, and engraving soft metals, such as copper, brass, silver, aluminum, and pewter.



Working copper with the many-purpose hand tool

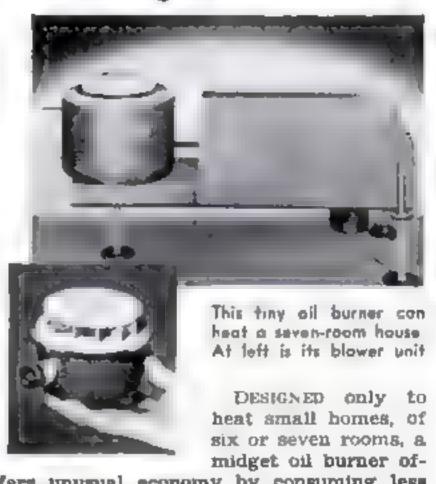
Insulating Lath Board Is Resistant to Fire



Mineral-Impregnated board stands a blowtorch test

For Fire protection, an insulating lath board interlaces wood fibers with minute flakes of vermiculite, a mineral related to mics. Partitions made by covering it with poultry wire and plaster hold back flames at least an hour, underwriters' tests show.

Economical Midget Oil Burner for Heating the Small Home



fers unusual economy by consuming less than a gallon of No. 3 oil during an hour's operation. Complete with room thermostat and automatic safety controls, the burner is of the vaporizing type. A tiny electric-powered blower supplies air to a combustion chamber mounted within the furnace. "They Made the Grade" ... SO CAN YOU!

Big names in the musical world, like ARTIE SHAW and NICK FATOOL, are usually associated with GRETSCH DRUMS, because they know that these famous matruments have led the

drum world for 57 years. A money-making career may be awaiting you as a star drummer in a big band ... but start with the best, a GRETSCH, NICK FATOOL chosen above all other drums by dozens of the greatest drummers in America.

Send penny poetcard for literature and FREE photograph of your favorite drummer; also full information about EASY-PAYMENT PLAN and FREE trial. Give street number; address Dept. PS 12-

The FRED. GRETSCH MFG. CO. Musical Instrument Makers Since 1885 60 BROADWAY, BROOKLYN, M. Y.





ARETSCH also offers SUPER VALUES in Guitars. Saxophones, Trampets, Trambones, Accordions. Bend for FREE estalogue. Mention instrument.

Huge hereuses in Lin Angeles actions actions the remoit supply the demand for graduates I arest training offered for At line Printing him needing Mechanics tes, Brafting Peaducilies, Mechanics and instruments test it as 24 quality enturing One of Arise on a new modern equipped and strategies by located action in This approved by 1 M. Convenience for Ground Plight and Master Rechanges its story. We to for the average training of the Age.

CALIFORNIA OS ANIGELES MUNICIPAL AIRPORT . INGLEWOOD CAL'S

Good Hying for Hife in your own chicken bro tern wis bustness hasiness to be in learn latest success methods from home track-ing course of H M Latinus. Profitable famous Pou try Espert darand gradhates cullogen this lead of Poultrymen Write for big dears stive book. How To its se Poultry For Prus. Sent Free Mational Poultry Institute, Dept. 51.5, Adams Center, M. V.



MAKING

Same a impathed method that has belied train evalues of Ter-Printed Wash Tubba Out Our Way Within a Wishle-ling by Friend Strange As It Seems See et Age Harte a Wash Tubba Out Our Way Within a Whale the fire of the length of the for the large that the for the large Chart the length that the for the large Chart the length that the for the large Chart the length man and ful details a water are the Langon tengot man 190 a hangest this Occasion to





14p | h . u of goal your THE TAMELYN SCHOOL OF PENMANSHIP 435 Ridge Duilding

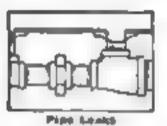
DO YOU COLLECT STAMPS?

See Page 39



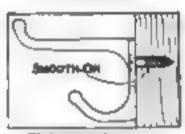
"Woulworth, Krazge, Newborry, Murphy, McCrary, Heisner, McLellan, Sears, Ward, Scott new featuring SQ-LO."

The Practical Low-Cost Way of Making **Home Repairs**



Anchoring in masonry





Tightening looss or

Smooth-On No. 1 will enable any handy man to do dozens of repair jobs like stopping leaks of steam, water, oil or gas in boilers, heaters, tanks, and piping; sealing cracks in castings of furnaces, radiators, automobile engines, gear cases, and machinery; tightening metal fixtures and loose parts of furniture, utensils, hardware, and around the automobile.

Smooth-On costs little, is easy to apply, and assures a lasting repair which atrengthens with time. A small-size can contains enough Smooth-On for a large number of jobs, and the unused portion does not deteriorate. Buy a can today, so you will be prepared for emergencies that might occur at any time

Buy Smeach-On No. 1 in 124-on . 7 on., 3-th. or 5 fo, cars from your hardware store or if necessary, from as For your protection, insist on Smooth-On, used by mechanics and repair man since 1896.



FREE

40 Page Repair Handbook which con-tains dorens of auggestions, not pub-lished elsewhere for saving time and money on household, auto and shop repairs. 170 Diagrams To obtain your copy of this useful manual without charge, 60 in and mail the coupon today

SMOOTH-ON MEG. CO., 574 Communique Ave., Dept. 58, Jersey City N J. Please send the free Smooth-On Re-

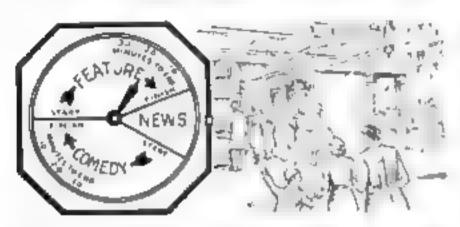


Address 1 43

Please mention Popular Science when writing to advertisers.

With the Inventors

UST what a movie patron will see on the screen of a movie theater, when he goes in, may be learned from an indicator to be mounted near the ticket window. Thus he can avoid sitting through an unfinished part of a program, and enter at just the right time for the beginning of the feature, news-



reet, or comedy, as he prefers. In this scheme, invented by Arthur G. Gross, of Beverly Hills, Calif., a "clock" dial is divided into segments proportional to the relative time each program item consumes. A rotating pointer then indicates which is now showing, and when it will end. An electric clock drives the pointer, through adjustable gears that may be preset according to the total time of the complete showing. . . . The U. S. Patent Office now grants more than 43,000 patents yearly . . . STRIKING MATCHES of the book type safely and effectively is the object of a cover designed by

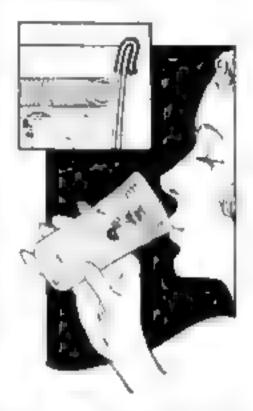


Charles C. Baldwin, of St. Louis, Mo. Unfolded, two ranks of matches reveal striking surfaces within each end of the base. When a match is detached, placed with the head inside the folder. and withdrawn under gentle pressure as shown in the illustration, the match lights up. Besides preventing accidental ignition of the

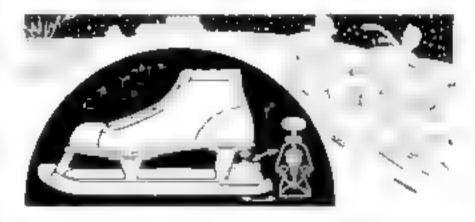
other matches, the idea has added advantages. Dampness does not reach the inside striking surface, to cause misfire; and the possibility of holding the match steady makes it easier to light a cigarette in the wind. . . . No MATTER HOW MANY levers,

cams, and cogwheels an inventor's fancy may put together, he cannot patent his invention if it is useless. In some way—possibly as a toy, a turbine, or a tuba—it must serve a real need... Frederick B. Chapman, of Greenwich, Conn., has devised a way to keep ice or fruit from clogging the lip of

a beverage glass. His solution, an "lce-retaining guard," consists of a ring-shaped coil spring of nickel or stainless steel, to be inserted in a glass just before serving. Within reasonable limits the device will fit glassware of varying size and shape. and is held securely in place by rubber-lined hooks that will not chip the rim. If desired, colored or numbered



identifying symbols may be attached to the spring inserts, indicating whose glass is whose if they are refilled. . . . WOMEN INVENTORS account for one out of every seventy patents issued, and their proportion of the total is steadily growing . . . By converting standard ice skates for use on packed snow, Oscar Nygaard, of Saugus, Mass., hopes to make "snow skating" as popular as coasting or skiing. He proposes detachable, auxiliary skate runners with wide bases, grooved lengthwise to prevent skidding. By means of thumbscrews they could quickly be fitted to any type of ice



skate, including shoe-attached skates of the popular tubular design. An ingenious support bears upon the sides of the skate alone, preventing the under side of the blade from being dulled by contact with metal, and giving a springy ride in gliding

(Continued on page 22)

THESE FREE BOOKS ARE FOR INVESTMENTORS

AND OTHER MEN WITH IDEAS

"We're only entering the great period of inventive advancement"

-says C. F. Kettering, Vice Pres., General Motors.

SOMETIMES we hear people say: "Well, there isn't much left to invent." But Charles F. Kettering, Vice-Pres and Head of Research of General Motors, who helped develop the self-starter, Duco and many other outstanding inventions, doesn't think that at all. Not long ago in a published statement, he said:

"If we had more men working out new inventions, new things, we could snap out of this depression in no time. Our return to normal times depends on new manufactured products that will catch the purchaser's eye, get him to buy and thus start the ball rolling. Change and buying go together. We are only entering the great period of inventive advancement."

Many Little Ideas Have Big Commercial Possibilities

Some of the world's best inventions came from men who didn't consider themselves inventors at all. The telegraph was invented by a painter, the typewriter by a farmer the hand camera by a bank-clerk, the stock ticker by a dentist. Or look at small inventions. A husband noticed his wife bending a hair pin to make it stay put. That gave him the idea of the crinkly hair pin. One day a golfer got the idea to make a wooden tee. Now wooden tees are sold by the millions every year. There are many similar exemples in inventive history. That is why we say that the books shown here are for INVENTORS and Other Men with IDEAS. Whether you consider yourself an inventor or not if you have an idea that will make money, save time, save labor, or give pleasure—find out how you can protect your rights to it

Our Business Is to Help You

For forty-three years, this organization has been in the husiness of helping inventors. During that time inventions from every corner of the country have been turned over to us to protect. Some ideas have represented complicated mechanisms others have been small, practical articles like a can opener or a new toy. All this has given us a wealth of experience to use for the inventor of loday. Here in Washington, we maintain a large staff of experienced Patent Specialists to give you prompt and expert service. Yet because we work efficiently our fees are low, and if desired we help you with deferred payments. But first, find out exactly what to do to protect yourself. Decide on that loday by sending for your FREE copies of the books shown above.



PATENT YOUR IDEAS

HOW TO OBTAIN A PATENT

Written by a Former Member of the Example of Corps (1922-24) of the U.S. Fatest Office. If you want to profit by your idea, you should take steps to apply for a U.S. Fatest at once. Your first step is to get this Free Book. This interesting illustrated book contains valuable information you should have. It tells you fully how to obtain a patest on your idea in the quickest way. With this Free Book you will also receive a Bressed of invention? form on which you can easily record your idea. Personal and Confidential Service Your case will be personally handled only by a Registered Patent Attorney who is also a Former Member of the U.S. Patent Office, All communications confidential.

MAA COUPM THEST IN THE PATENT TOOK AT FIXER OF INVENTOR Form

REGISTERED PATENT ATTORNEY FORMER MEMBER EXAMINING CORPS B. S. PATENT-OFFICE

Westworth Bidg., 35th Finer, Dept. 11-C, New York City MILLER BUILDING, Dept. 11-C, WASHINGTON, D. C. Please send me your Free Book, "How to Obtain a Patent," and your "Record of invention" form.

NAME ...

ADDRESS

PATENTS SEND FOR

et Costs and Other Useful Information About Patents EUGENE H. PURDY, Registered Patent Attorney 1926 INTERNATIONAL BLDG. WASHINGTON, D. C.

NAME

ADDRESS



Inventions: Wanted

We have been a constituty selling inventions, parented and unparented since 1924. Write us. If you have a practical, theful idea for an e

Chartered Institute of American Inventors
Dept. 3. Barrister Building Washington, D. C.

PATENTS-TRADE MARKS

All cases submitted given personal attention

Form "Evidence of Conception with instructions
for use and "Schedule of Government and

Attorneys" Fees"—FREE!

LANCASTER, ALLWINE & ROMMEL
(Palent Law Offices)

413 Bowen Bldg.

Washington, D. C.



LEARN CARTOONING!

PATENTS PERSONAL SERVICE

My Personal service natures strictest confidence on all your patent problems Send me a model or drawing, or

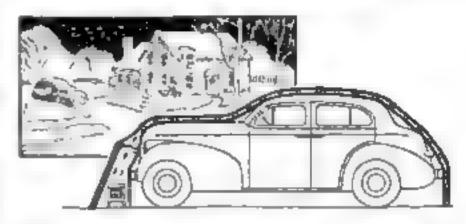
sketch and description of your invention and \$5.00. I will make a most and report promptly as to its patentability and send you a copy of my 72-page booklet Dr. if you prefer to read my booklet first, write today for PREE copy. Registered Patent Attorney

L. F. Randolph, 340-D Victor Bidg., Washington, D.C.

With the Inventors

(Continued from page 20)

over the snow. . . . KEEPING A CAR WARM by heating a whole garage seems uneconomical to Augustus L. Clark, of Montpelier, Vt., so he has invented a special blanket for the car alone. It also may be used to advantage when the machine must be left standing outdoors for a considerable time. To



keep the radiator water from freezing, a front extension of the blanket frame forms a hood to accommodate a gas, oil, or electric stove. Heated air circulates between double layers of the reënforced blanket, and, emerging from holes in the inner layer, surrounds the car. If a gas or oil stove is used, a hole in the front of the blanket serves as a vent for the fumes. A second hole, nearer the floor level, admits air for combustion. . . . U. S. PATENTS ARE VALID in Alaska, Hawaii, and the Canal Zone; also, subject to certain regulation, in Puerto Rico, the Philippines, the Virgin Islands,

and Guam . . . A HEADLAMP that illuminates shop work, while leaving both hands free, has been devised by Benjamin Cooke. Hempstead, N. Y. It a lightweight, comfortable head clamp of metal spring wire supports the socket with its bulb and reflector, the latter being equipped with a visor to avoid throwing light into the



wearer's eyes. Semirigid rubber insulation keeps the electric cord, from the nearest outlet, clear of the worker's head. Additional insulation between the socket and the head clamp eliminates any possibility of electric shock. The invention can also be

(Continued on page 23)

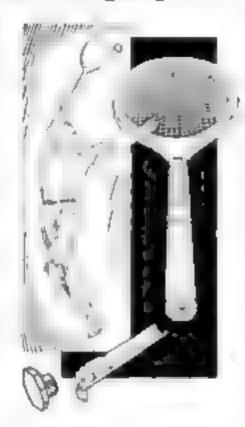
Please mention Popular Science when writing to advertises

With the Inventors

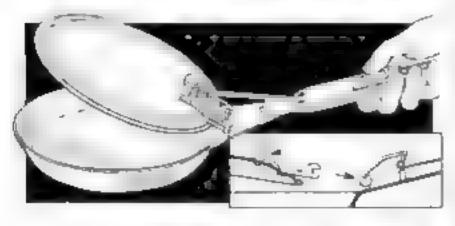
(Continued from page 22)

adapted to operate from any standard automobile battery, thus serving as a handy trouble light.... ONE OF THE YOUNGEST INVENTORS in the country is sixteen-yearold Seymour Golub, of Brooklyn, N. Y., who received a special award of merit for his invention of an automatic lighting device

... EVEN THE FUSS-IEST of tennis players should be satisfied with a racket balanced according to the system of Mercer Beasley, of New York City. He takes care of them all—the novice who finds a normal racket too hard to swing, the advanced player who wants more weight behind his stroke. and stars who would vary the balance of favorite



rackets for clay and grass courts. A notched rubber weight, interchangeable in various compartments of a semicircular sheath, is simply slid into a tight-fitting hole in the handle. This compresses the metal sheath so that sharp points on it grip the rubber, and a screw cap at the base holds sheath and weight firmly in place. The exterior of the handle bears a scale to aid in obtaining or duplicating the correct adjustment. . . . By providing a frying pan with a lid and a convenient lifter for it, John F. Fratis, of Repress, Calif., does a good turn for house-wives and campers. Burning-hot grease



cannot spatter while the lid is in place. To inspect the contents of the pan, the lid is raised simply by drawing back the thumb against a knurled slide on the handle. Releasing the slide allows the lid to close without jarring. Whenever desired, the lid and lifting mechanism may be detached.



Write or Print Name Clearly

THESE practical, easy-to-understand handbooks will help

THE MOST PRACTICAL, EASY-TO-FOLLOW EASY-TO-FOLLOW MANUALS EVER PUBLISHED

THESE practical, easy-to-understand handbooks will help you get the most out of your hobby. Written by experts especially for Popular Science Monthly readers, they are invaluable to the mechanically minded man. Each book is fully illustrated, with pictures and diagrams. Bound in sturdy library cloth. You need not hesitate to order them for yourself or for gifts. We guarantee complete satisfaction or money back.

FIX IT YOURSELF

Save yourself a lot of expense by doing your own odd repair jobs. This famous book shows with diagrams and directions how to fix and repair furniture, electric outlets, windows, doors, leaky pipes, floor boards, chimneys, ballers, weather proofing, pointing and hundreds of other construction and repair jobs. Picture diagrams show how each job is done. 256 pages. Full cloth bound, \$1.40.

RADIO BEGINNERS SIMPLIFIED MANUAL

Every radio operation from trouble shooting, to building and impreving marvelow long and short wave sets, is made so simple and clear that you just cannot fail to understand many things that may have puzzled you before. A few minutes a day with this manual will teach you what it takes years to learn without R. Propared by technical radio experts who KNOW how to explain things for non-technical radio enthusiants. Cloth bound, 256 pages, hundreds of simplified drawings and diagrams, \$2.00.

MODEL RAILWAYS

A practical handbook that shows how to lay out and operate a home-made model railroad. Easy-to-follow instructions for building a box car, gondola, refrigerator, tank, hopper, day-coach, pulmon, baggage, observation car, and Atlantic type locamotive. How to turn out firebases, boilers, and wheels in your own shop. How to make an illuminated dispatchers track diagram. How to build and install a black signal system, remote train control, automatic couplers, relays, etc. 256 pages, fully illustrated, full cloth bound, \$2.00.

DECORATIVE METAL WORK

Simplified for Buginners

A brand new manual that tells in easy-to-understand language how to make useful metal articles in your home workshop with simple tools. How to do intaying, spinning, cutting, etching, joining, plating and finishing. How to make jewelry, novelues, condic sticks, get trays, lamps, hardware, and other weeful metal articles. Full cloth bound, fully illustrated, \$2.00.

ELECTROPLATING

Written especially for the amoteur, this book tells you how to utilize many odds and ends to build a complete home electro-ploting workshop. Instructions, pictures, and diagrams show how easily you can do copper, nickel, chromium, silver and gold ploting. How you can plate household or automobile flatures, hardware, tools, silverware, amoments, clocks, watches, brocelets, rings, metal parts of all kinds. Scores of illustrations, diagrams, and pictures. 260 pages, full cloth bound, \$2.00.

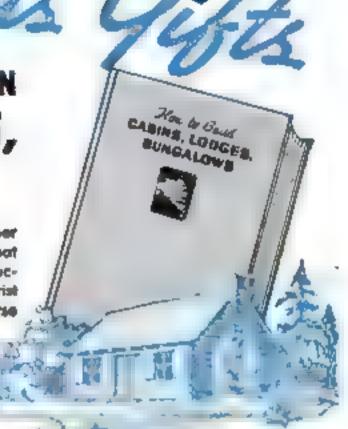
WOOD CARVING and WHITTLING

An Actistic and Interesting Hobby for All

This new practical handbook starts with the simplest kinds of wood carving and shows you step-by-step, how to become expert. How to carve figures of men, animals, birds, with simple hand-tools. Chip carving, include, level surface carving, relief carving explained. How to carve burnture, arrangements, frames, jewelry bases, trays, because chests, etc. Fully illustrated, 265 pages, full clath bound, \$2.00.

NOW IT'S EASY TO BUILD YOUR OWN
HUNTING and FISHING LODGES,
CABINS, BUNGALOWS

A big book of definite instructions for beginners. If you can handle a hommer and saw, there's no reason why you can't build a bang-up cabin in the woods that anyone would be glad to live in, or own. Complete plans, and step-by-step instructions for every stage of the work. Designs for numerous log cabins, lodges, tourist homes, wayside stands, bungalows. Not just a book of pictures but a full course of Instruction. Every problem of location, drainage, water supply, etc. is clearly explained. Tells how to cut and erect your structure — all about floors, roofs, windows, doors — how to do the whole job from foundation to chimney top. Don't imagine it's hard—when you see the book you'll be aching to grab some tools and get to work. 256 pps., full cloth bound, \$2.00.



BOOK OF RARE AND SECRET INFORMATION
THE BOOK OF FORMULAS - 250 PAGES

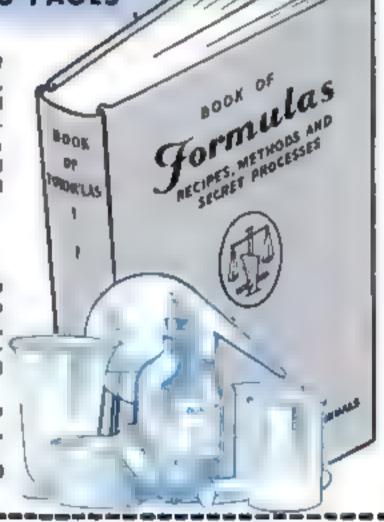
The basis of many fortunes? Formulas, recipes, methods and secret processes for making and improving upon beverages, glues, cements, enamels, points, casmetics, dyes, links, tooth pastes, soaps, silver and nickelplating, oils, lubricants, and a thousand and one things for commercial and household use! Your fortune may hang upon one little hint from this most amazing of books! Information from a thousand sources—not normally available to the general public—now published for the enjoyment and practical profit of our readers.

SEE WHAT YOU CAN MAKE

You can easily make mixtures to keep your windshield shining like crystal, whiten discolored teeth, keep silverware bright and clean. You can make beverages, or power belt dressings, perfumes, shampoos, bleaches, photographic solutions, essences and extracts, manufacture battery fillers or solutions, and do a thousand other things—all with the plain and easily followed formulas in this book.

If you like experimenting with things, either as a hobby or as a terious vacation, here are modern formulas which, taken as a base, may lead you to unique discoveries and profits.

Full cloth bound, \$1.00



SEND NO MONEY NOW! TEAR OFF AND MAIL THIS COUPON TODAY

OFULAK	SPICACE BIN	TIE, 363 POWETH	TARMINE ME	W TORK, N. T

few costs period in full payment when the books are delivered, [Money back if not extended.]

Fix It . . . \$1.00 Radio Experimenter . . \$2.00 Cabins . \$2,00. Wood Carving \$2:00 Metal Work . \$2.00 Formulas \$1.00 Electroplating \$2.00 Model Railways \$2.00

NAME

If you comit now we pay portuge. Orders from notated M. S. A. connet for sont C. O. D.



L. A. Rowe took in \$148 his first week. R. E. Traynor took in \$56 in one day and nearly \$800 in one month-W. F. Drake took in \$186 in three days. Men often take in \$.00 to \$.50 in a single week. Hundreds earning quick, easy profits. Electricity does the work. Washes rugs like new on sustamer's floor. Hundreds of customers in your own vicinity and nearby towns.

EASY TERMS

Equipment is not expensive. Pay part downbalance monthly. No shop necessary. Used by several great ratiroads and many large hotels, Manufactured since 1918 every machine guaranteed.

FREE BOOK

Send today for booklet litustrating Rug-Waster and tolling how you can eath large profite at prices below mber methods, how you can build a permanent business; and how you can pay of easy larme.

YON SCHRADER MFQ. CO. 361 Pl., Racine, Wis.



Free Books Answer Questions Tell How to Get Protection

 Your lileas may be worth money! Get facts first and save time and money Compefert nilvice on patent procedure is essential to good results. Our 63 years' experience enables us to explain every-

thing you need to know about protecting and commercializing your idea. Prompt, confidential service and results. Mail coupon today. Special "Certification of Invention" form also sent,

COUPON For FREE **BOOKS** Explaining:

* How to obtain a potent. . .

 How you can commercialize your petent. . .

Why you need a notest. . .

Correct way to proceed and custs

C. A. SNOW & CO. Registered Patent Attorneys Since 1878 211 SNOW BLDG., WASH., D.C.

Pieces send me the free books and form mentioned Without cost or chilgston.

NAME

ADDRESS.

U.S. Bureau of Standards states: "Off does NOT wear out mechanically and may be used rer and over again." (After reclaiming) Thousands of car, truck and tractor owners have proven the roth of this statement with the use of RECLAIMO. This revolutionary device filters

and rectalmeerankesse oil as you drive. Saves Time, Trouble and Money! Our 36-page illustrated booklet "OR. FACTS," contains complete details and Write for your copy today It a FIFE.

(Sold d rect and by reliable designs energy here)

RECLAMIO MFO. CO., 2306 M. Western, Copt. 56 CMKAGO



LATEST SCIENTIFIC CRIME DETECTION METHODS

Read This Amezing Book **30 DAYS FREE**

Explains with real cases latest methods of Scientific Crime Detection — finger printing — firearms identification—police photography, Takes you on the inside. Informative—exciting—valuable. Read 30 days free—then send only a dollar if you want to keep this amazing book. Your age must be stated. T. Q. Cooks, Dopt. 1361, 1920 Sunnyside Ave., Chicago

SAAFTSMEN NEEDED by makers of planes, motors, squipment

Good pay Special Assation Deafting course trains you QUICKLY at home in spare time. PREE Bullet n. No obligation. Address merican School, Dopt. A-148, Dresol at 58th, Chicago

(1561-1614) | 1614-1614 | 1614-1614 | 1614-1614 | 1614-1614 | 1614-1614 | 1614-1614 | 1614-1614 | 1614-1614 |

Want to Get Ahead Faster— Make More Money?

See EDUCATIONAL & INSTRUCTION

(地區南部天河區內區內區內區內區) 新國 新國 新國 新國 新國 新國 新國 新國

SHARE

Your Christmas Giving With The Salvation Army



WRITE

The Salvation Army Into Your Will

医克尔氏征 医阿拉拉氏试验检检检检检检检检检检检检检检检检检检检检检检

U.S.GOV'TJOBS

SHORT HOURS-GOOD PAY -VACATIONS-PENSIONS

Stop worrying about strikes, layoffs, hard times! Get on the government payroll. No special education or experience usually required. Short hours: stendy work, vacations, Open to men and women citizens, of ages 18 to 50.

SEND POR PREE BOOK

It tells shout government positions; what to do to get job you want. Mail letter or postal card now for FREE book "How to Secure a Government Pouition", Address PATTERSON SCHOOL, 161 Mercentile Bidg., Rechester, N. Y.

GLERK Start at \$1856 a year

INSPECTOR OF CUBTOMS Start of \$2 | 80 a year

RUBAL MAIL CARRIER Start at \$1800 a year

POST OFFICE GLEAK Start at \$1700 a year

hothly made easy though N Y I Training Terminal maching by leadthe photograp sers has not us flest Spice it opportunities I officered. News Portratt. Motion Pictors. A he its og and t set Change. Paphy Persons, Assendance and Home Study I street Bookset, N Y INSTITUTE OF PHOTOGRAPHY Dogs, 5, 40 West 13cd St., New York, N Y (30th Year) Bookert FREE!

SHORT-CUTS"

Learn low to test and fix all radio sets. Hundreds of time-saving bints for all esecuts. Get this new 32 page Rudlo Book for only a dime. SUPREME PUBLICATIONS, 3728 W. Little \$4., Chicago, Hilania

LEARN COMMERICAL

This is age of rolor and beauty-a go un era for blustrators and designers. Tuen your drawing to est into money Become e Pre-

Canto gradess onal skall glackly an apare tone at home Send for free books e and full betalts Amatrure here a your chance!

SCHOOL OF APPLIED ART

SCHOOL OF AERONAUTIES

tained to St ART to for tenary a forest report for many of your choice of existing to extra Figure Engineer on Me than to. Radio. Approved by U.S. Unit Association Assistant to 17 modern a phases, intent at raft engineer complete programmed above to boundaries or east spends to forest for

LET BOILWOL PICK A JUN JER TRU

TODAY guiding a job or chossing a return to an interest a life of mine that Science concern accurate a determine for our in advance just what hyperof work or profession possess bout suited for FREE Head have rame on a point process for FREE containing this new person will be greater the rusa Vocational Guidance Associates Dept 21 Turbon Ariz,

Send postcard for our free catalogue.

Thousand of bargains. Address
HALDEMAN-JULIUS CO., Catalogue
Dept. Desk M-J64, OTRAND KANSAS

R Bargains Send No Money-

Benuits Underwoods. Ropply, etc., refinished \$100 office models gres is reduced to about by mich one i price in day rea for a guaranteed-rang lemma-10c a day. Fee cuta-of 1 to the energy lemma-10c a day. Fee cuta-of 1 to the energy lemma-10c a day. Fee cuta-of 1 to the energy lemma-10c a day. Fee cuta-of 1 to the energy lemma-10c at lemma-10

SEND NO MONEY!—Save Money!









Transparent **BOOFLESS** 80 Duys! Trial!

Wa make FALSE TEETIS for you by MAIL. 1000 your own mouth-impression, Manay- to \$35.

FREE Free impression material directions, estalog

U.S. Dental Co., Dept. 1-42 Chicago, Ill.



Radio between the covers of one great book! From the smallest part to big outomatic pheno-combinations, everything is here. Lafayatta Radios for the home, farm, comp or cor-pick the one you want and whether you'll pay \$10 or \$100 you'll be saving real money

FOR THE EXPERIMENTER

Build-it-yourself Kits for new Frequency Modulation, or Television, Amotour transmitting sets, etc. Thrills, excitement, education — and what i more, good solid training for future big paying jobs. Get this FREE Catales see for yourself.

FOR THE SERVICEMEN

Thousands of parts, every type tube. Save time and money, thep Lafayette. Own up-to-the minute test and sound equipment. Dan't waste valuable hours took no around-you know you can get at from Lafayette, so rush coupen now.



BIG XHAS GUIDE SAVE ON GIFTS!

Here's the way to save money this Xmas on worthwhile gifts. This Free book lists hundreds of great Buys" in radio, cameras, toys and appliances. All the "Big Names" at reduced prices—send for your copy now

abayetteRadio

MAIL THE COUPON. HEW TORE, N. T. CHICAGO ILL ni kton Man ATLANTA SA 365 Ponchine Street SOLTON MASS SHOKE M T NEWARK N. J.

LAFATETTE RADIO CORF. Dopt. 9A1 90) W. JACKSON BLVD., CHICAGO, ILL or 100 SIXTH AVENUE, NEW YORK, N. Y.

Plaque rush FREE Cotolog No. 82

Please rush FREE XMAS Book



ADDRESS

CITY.

JAMA CA. L J.



You got Prejectional Test Equipment
Plus Experimental Outlin

, Includes 140 RAD () PARTS to bottle complete flore ver HADIO TIROI 4 god 4 modern That
FR-ANALYZER how a por refer to 2 BIC St. P
MFNTS OF HADIO Eq. IPMENT for conducting
actual experiments with your own hands.

Karn While You Learn

My B. NINEMS ht till its above you have to put your equipment to actual user in handing money making Harry or Jube shortly after you begin Tre ning THE SPHAYBERRY COURSE IS SOLD UNDER MONEY BACK AGREEMENT

RUSH COUPON for DIG FREE BOOK

SPRATBLERY ACADEMY OF HADIO F. L. Sprayberry, President 482-A University Place N W Wesnington, D. C. MAKE MONEY IN RADIO

Name Address

State Mail in curciose or basic coupon on s



Step 10 years chead AT DNCE in accounting experience

with this famous 1 742-page handbook of expert practice. Save time effort in any situation from simple bookkeeping to higher accounting increases your ability to handle new problems: helps you dis-play kind of skill that wine recognition, ad-vencement. Records, systems, budgets, pro-cedures reports and shalysis; forms 31 btg sections, complete in one volume, the

ACCOUNTANTS' HANDROOK

Nothing else like it-ever 160,000 in use by executives, financial men, accountants, Editorial Board of 70 experts. Content would fill 10 unual books.

FREE Mal coupon below for 32-page and a very attention to have the kind of to formation with the product at I departments of pre-unity flow cost. of this great Randbook

summers they and mail this request form any one THE RONALD PRESS COMPANY.

Dept M433 18 East 26th Street, New York, M. Y. Solid me without charge, the 's page sample with full information along the Accountants' Mandbook,

Name (please or of

Occupation

Address

Tan SKINS, Make Up FURS

So a Taxidermiat We beach you at North.
Moant Birth, Animals, Pets, Game Woods, Fish,
Save your hosting trephies, decarate home and
for MARE MONEY Mount and Errors in
for others, My space-time profits.

FREE BOOK 100 games sictures
get this wanderful book It a New Free,
cand post earl TODAY. State your ALL. MORTHWEST SCHOOL OF TAXIDERMY Dopt. 329 (



WOODWORKER'S Turning & Joining MANUAL



This new manual is written especially for the man who likes to make things in his own home with power tools. Tells what power machinery you will need to

turn out beautifully finished furniture. How to use the cross cut saw, ripsaw, miter saw, jointer, and band saw. How to bore and mortise by machinery,

Scraping method of wood turning fully explained-how to turn a plain cylinder, smooth cylinder, how to use a skew chisel to square ends, how to make shoulder cuts, taper cuts, convex and concave cuts. How to make a tilt-top table, occasional table, reeding and fluting, faceplate and chuck turning, turning rings, vencering. How to make the surface perfect, how to apply stain, wood fillers, finishes-wax, oil, shellac, varnish, lacquer

Also, how to equip your home workshop, what hand tools you will need in addition to power machinery.

All about wood joints.

Complete working diagrams with step-by-step inetructions for intricate designs in cabinet making, 236 illustrations, 192 pages, full cloth bound, only \$1.00 COD Send order WITH NO MONEY for WOOD-WORKER'S TURNING AND JOINING MANUAL. Pay postman \$1.00 plus few cents postage when book

POPULAR SCIENCE-Dept. 11

353 Fourth Ave.

New York, N. Y.

At last a service and repair manual has been made for the auto owner who is not a mechanic. Here are bundreds of horse-sense" methods for keeping your own car in perfect shape—no matter how old or how new it is. AUTO KINKS tells in non technical language, made clearer by drawings and simple diagrams, what to do no matter what spes wrong-bow to make temporary or permanent repairs to the motor, carburetor, ignition, lights, starter, radiator, chassis running gest body fenders top, and even the gatage. Will give you more understanding of the mysterious "insides" of a car than anything you ever saw Service men will get a world of new ideas from it too. 192 pages, full strong cloth binding, pictures on every page. Only \$1.00. Sent C. O. D. plus few cents postage. Ask for "AUTO KINKS." Write to

Popular Science Menthly, Dept. 11, 353-4th Ave., New York, N. Y.

Please mention Popular Science when writing to advertisers.

CHEAP OIL BURNER Sweeping the Country!

In Your Present Store or Furnace-

-No Drudgery Dirt or Ask-as-latence Heet Quick at SMALL COST.

OVER 40,000 SOLD

Beats any cheap burner ever gotten out for low cost, efficient performance. Burns ordinary low priced free flowing oil, without pre-generating or closure up. Quick interns heat by Bimple Torn of Valva. AGENTS

30DAYS' TRIAL

Prove its efficiency, convenience and economical operation

Write Immediately 🔙 SPECIAL OFFER TV AGENTE

Salesmen BIG MONEY

F Blaveranges * 1 can depose of 250 HEAT KINGS before the Year ands ! Write us n w for agrous



Quick HEAT at Turn of Valval

who will demonstrate and take orders. Write quick, he first to team how to make HEAL MONEY cight new, spare or full lime- such it postered today. UNITED FACTORIES, A-761, Factory Bidg., Hansas City, Mo.

Welding Body & Fender Repair of Training Michigan a Olden & Behool Train until Battaffed Acety & Aro Practical Shop Trade Walverine School of Trades, 14 LO W. Fort, Detroit, M. ch

ERRCULAR

This Lincoln School wants to tomedia ely get la fouca with men interested in preparing bow for positions as Astunautica Engineers. Two year course adjustable to Right School or Cullege Graduates includes wide practical experience in Airplane Design and construction Next tlass staffs " Write today for complete information

LINCOLA AERONAUTICAL INSTITUTE (INC)

A recest By laing



Wonders Through The MICROSCOPE

A new book which tells you all about MICROSCOPY. Turn on inexpensive microscope on hundreds of specimens with-

in a stone s throw of your front door and you step off into a new world of wonders. Complete Manual for aniateurs. How to use equipment, secure and preserve specimens, take plotonderographs, etc. Numerous illustrations. Full cloth bound \$1,00.

POPULAR SCIENCE MONTHLY, Dept. 11

353 Fourth Ava.

New York, N. Y.

When Writing Advertisers Please Mention POPULAR SCIENCE

LOW \$6.85

from your own impressions. You have lon or MONEY BACK GUARANTEE. satisfaction but you be your own judge.



WRITE TODAY for PREE SEND NO MONEY CLEVELAND DENTAL SUPPLY COMPANY

Dept. 33-At, East St. Louis, Illinois



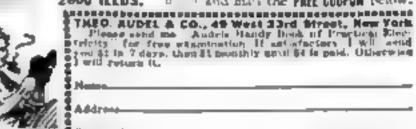
For Engineers, Electricians, Students and all interv KANDY ested to Electricity. A quick, amplified, testly leterence, giving complete metruction and practical information. Easy to uncerstand. A reliable avthorary and a bandy belper that answers your questions. • INSIDE TRADE EUFORMATUIN ON

> The Rules and Laws of Electricfry-Maintenance of Machinery-A. C. and D. C. Motore-Armature Winding and Repair-Wire ing Dugrams - House Lighting-Power Wiczng ~ Cable Spining ~ Meters-Basteries-Transformers Bie va ora e Bleutric Cranes e Ranwaya-Bella-Sign Flashers-

Telephone-Ignition-Radio Print capies - Retrageration - Air Con-ditioning - Oil Burnezs - Air Compressore Welding, and many Medern Applications explained so

PBM

can understand. 1340 PAGES this agest ance for yourself simply Z600 ILLUS. " and man the FREE COUPON beant.



EAD FOR PROFITE

* Reference

START \$1260 to \$2100 YEAR

v

Thousands Appointments each year

Get ready now for 1941 Examinations

32 Page Civil Service Book -FREE

Mail Coupon Today-SURE

INSTITUTE Dept. L245 Rochester, N. Y.

FRANKLIN

Gentlemen: Rush to me, FREE of charge, list of U. S. Government big pay Jobs. Send me FREE 33-page

book describing salaries, vacaticulars telling how to qualify for one of these jobs.

1	Name	++++++++++++++++++++++++++++++++++++++

JANUARY, 1941

Please mention Popular Science Monthly when writing to advertisers.

Now is the time for you to get into DRAFTING



Complete failed formitted All mecessary toors are cluding a away takes, Rent to you at more without extra charge. -Learn at home from an Engineer

With Industry working feverishly on rearmament, new products, new production methods—the field for DRAFTS-MFN is bigger than ever! Get into a better job with more pay and fascination, pleasant work. I will train you at home in your space time until you are ready for a better paying position by my practical applied method—on actual jobs—as I have done with many hundreds of successful students.

Industrial Designing Included

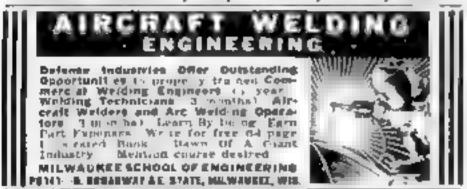
My practical training in drafting also includes a working course in Industrial franching as at the to new products, improving, restricted and modern, and — all estremely reliable to draftsmen. Send course for complete details on Drafting and Industrial Designing?. Engineer Dube, Libertyride, Richard.

T'GET THE FACTS! Engineer	Dobe, Div. 3391 au
Please send me full facts on "Drafting and son". Also how you avaist your graduates in these fields.	Industrial Dealers
Name and	Are
Address	
Town	Plate.

GET A DRAFTING JOB

Drafting Jobs Often Pay \$175.00-\$350.00 month. Trained draftsman always in demand. Learn easily at home in spare time. Experience unnecessary. Common aducation enough, Employment service PREE Write today for complete information. No abligation. No salesmen.

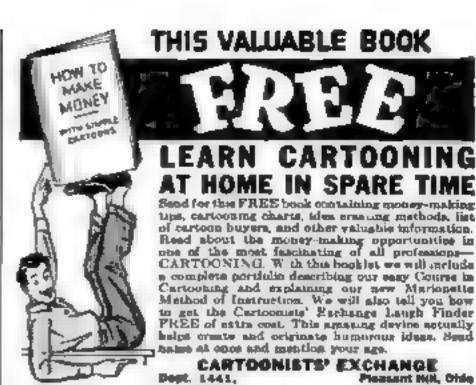
MONROE INSTITUTE, Dept. 8-201, Alfon, Illinois



DECORATIVE METAL WORK

A new manual for the amateur Tells in easy to understand language how to make useful metal articles in your home workshop. You'll be surprised how easy and interesting metal work really is Fully illustrated with diagrams and step-by-step instructions Sturdy cloth binding. 363 pages. Send only \$2.00 and your copy will be sent postpaid. Popular Science Manthly—Dept. 31, 333 4th Ave., New York, N. Y.





628 p. CATALOG, 9000 NOVELTIES

Rush in. Off pares, 2000 Historicions, 9000 sovelies, Hadres, cameras, epilera quoda jeur es benda à sectio hobby hits live animata, guns joke goods, magic aport tiens from cul instruments, summers, wige auto & bite accessories, which in the matter altitus amoker's movelles fortune telling articles, watered developers religious activities, articles, preferry fencing accessories matter developers religious activities, articles, preferry fencing accessories.

**BONNEGON SMITH & CO. DEPT. 111.

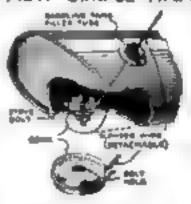
SENSATIONAL OIL BURNER INVENTION

Makes and burns its own clean hot gas when and as needed No hose no amake no sent no sabe. Burns total air and did cheap kerssens M. Jone of prospects So a fact I hopes crategrates reads de stands factor as and hundreds of others. His money-maker for agents and distributors. Write quick Liberty Burner Co., Gept. 8-131, 820 M. Michigan Ave., Chicago, Ill.

When Writing Advertisers
Please Mention POPULAR SCIENCE

Be Your Own Auto Trouble Shooter

NEW SIMPLE HANDBOOK MAKES IT EASY



A reduced drawing from AUTO KINKS showing how to resolv hole in passing tank without selder-ling, Camplete engineering

Now you can cut down monthly repair bills and keep your car in A-1 condition by doing yourself many easy tasks completely explained in this manual.

Anyone can follow the non-technical language in AUTO KINKS fully illustrated with drawings and simple diagrams, and find out just what to do no matter what goes wrong—how to make temporary or permanent repairs to the motor, carburetor, fuel line, ignition, lights, starter, radiator, chassis, running gear, body, fender, top, and even the garage.

AUTO KINKS is a complete service manual which will save you many times its cost. Besides cutting your repair bills, you will get a lot of fun out of doing these simple jobs yourself. 192 pages, full strong cloth binding, pictures on every page, only \$1.00 C.O D. plus a few cents postage.

POPULAR SCIENCE MONTHLY—Dept. 11 353 Fourth Ave., New York, N. Y.

Send me AUTO KINKS. I agree to pay the postmen \$1.00 plus a few cents postage when the book arrives. If I am not entirely satisfied with the book, I will return it to you within 5 days of receipt and you will refund my money in full.

Name	The Edward Liddle commonly represent
	Carlotta - Terramone and de de residid de
City State	







LEARN TO

You'll be proud of yourself when you've acquired the knack of carving these quaint wooden figures. The Skipper Sam'l Whittling Kit contains step-by-step instructions and material for carving TWO Sea Captains. A special steel knife -eharpening stone, and paints are included. Send only \$1.50 and the complete Kit will be sent at once.

POPULAR SCIENCE MONTHLY.

Dopt. II

353 Fourth Avenue

New York



SIX SCOTT

A new Kit containing material for whattling BIX Interesting little Reottle douts each in different characteristic poss. Each Scottle is about 2 luches long and the six wood blocks supplied. are ready eat to the correct outline Nothing elec needed beel pocketknife, Complete Kit ontaining 6 shaped blocks.

paint and brush, pocket charpening stone, material for eyes, and complete illustrated step-by-step instructions will be sent for only \$1 00 postpaid to the United States or Canada Get started in this new Hobby NOW. It s easy with this new Kit.

POPULAR SCIENCE MONTHLY DOGG 11 New York, N. Y. 353 Fourth Ave.

Cel. Hartney's Complete Only Se

Lieut, Col. Harold E. Hartsty U S. AIR CORPS. RES.

Formerly Chief of Training, U.S.A.C. Commander, 1st Pursuit Group, A.L.F.



He Teaches You-LOOPING. APINNING. HALP ROLL ON TO BACK SLOW ROLL. FLICK HALF ROLL, ETC., ETC., MITC.



SEND NO MONEY—Money Back If Not Satisfied

Written by a practical Chief of Air Training, this course of 26 leasons will enable you to greep any flying instructor's directions more quickly. You get the brief and clear instructions of an experienced pilot and the simple movie like diagrams with each ground and air lesson enable the beginner to see at once just what to do—and remember it clearly when in the air The order of lessons is the same as in important flying schools, so this book gives you a splendid reading preparation for actual experience in a plane Air navigation, map and directory of airports included. Just mail coupon. Book sent COD, plus few cents postage of we pay postage if you send \$1.00. Money back at once if you return manual in 5 days.

MATIONAL ATRONAUTICS COUNCIL, Inc., Bopt. 801, 37 W 47th St. New York.

Send for 5 days' free reading Col Hartney's Complete Manual of Thying I will may postman only \$1 M Plus few cents postage. You are to refund my dollar at more if I esturn book.

Nome

Address

City State Send \$1.00 pad or alead pasters. Same estura privilege

I'M SO HAPPY NOW THAT CHARLES IS DOING SO WELL IN HIS NEW BUSINESS rook in *217

Newly Invested machine washes waste 5

washing You don't have to tent a more or office. You operate fills business from your barns. The expense for materials is small. What you take in it practically all parts. Do a \$10 his cost for materials is small. What you take in it practically all parts. Do a \$10 his cost for materials. Description of the White proof of the parts of the White proof of the parts of the White proof which washes paint beautifully and postpones repainting many years. many yours.

Rurold Josep writes: "I landed a pao job gig figus, day."

J. Cranston mye: "There Merces) and to start on Mesoder, thunks to your help.

Orde Brankt writer: "I made a demonstration in a probler erhood and get a routened which will more

then pur for my marking in the seat for days."

von schrader



Easy Payments

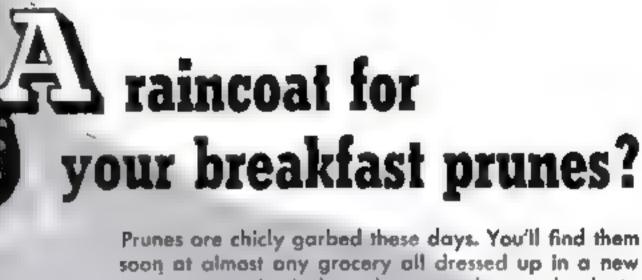
It takes only a few deliars to get started in this money making profession. No experiodes generately. The total price is so small said the payments so may that anyone with ambilion should get started NOW.

SEND FOR FREE INFORMATION

There is No Obligation

MANUFACTURING CO. 742 Ft. Rasine, Wisconsin.

Please mention Popular Science when writing to advertisers.



Prunes are chicky garbed these days. You'll find them soon at almost any grocery all dressed up in a new transparent, elastic bag that snuggles so closely to them, and is so waterproof, that not a drop of water or air can sneak inside. The Goodyear people, who make it and coil it Photilm, say it's the greatest scientific advance in air-tight, elastic packaging in recent years., Popular Science on-the-screen agrees I. . . and takes you behind the scenes in the current issue. Don't miss it.

Men...beware of the Lady's Eyes!

Yes, bewarel For all you know those romantic blue optics may not be her own. The story behind this fantasy of charm comes from Hollywood where they're using contact lenses to make character make-up more authentic . . . or match the lady's eyes to her evening gown. You'll enjoy seeing how science helps the movies . . . and fashion . . . in the latest Popular Science on-the-screen. Be sure to see it.



popular science on-the-screen



Classified Ads only 35 per word per insertion, payable in advance.

Minimum ad 10 words. To be included in March issue copy should be in

our office by December 23. March issue on sale February 1.

POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY

ADVERTISING

MAIL-ORDER or agent ad reach or 1 000 000 families throughout United States \$14.00 inch. Newspaper, magazine. mailing agency, 20-EP West Jackson, Chicago

LEARN Advertising at home. Easy practical plan No text books. Common school aducation sufficient. Interesting bookset and requirements free. Page-Davis School of Ad ettaing 1601 Michigan Avenus Dept 1741. Chicago

Ban Avenue Dept 1741 Chicago
DISPLAY Advertising 205 newspapers
aga s line \$1.47 Fide ity Advertisers.
K 3818 Washington Chicago

ADVERTIGE 24 words :49 newspapers, \$5.50 Lists Free Advertising Bureau, 4515 P Cot age Grove, Chicago

SPECIAL—Inch Display Adv 40 magazines Fr. 415. Wood's Popular Service-s Atlan ic Cr y

AGENTS WANTED

MYSTERY Invention carried in pocket keeps hands feet ears body comfortably warm on coldest days Lasts years. Stave warm 10 to 12 hours Lasts years. Stave warm 10 to 12 hours Lasts cagar lighter fill, directles one has feent Eve body buys workmen housewires school buys farmers, appriamen apectators. Se'l loothall games and other ou door gatherings Law prices. But profits. Write quick Kamiy Warmer Dept. E-2108 Eastern Ave., Cincipna I. Ohio.

DON T Be a Job Hun er Biart yout own business on our capital. No hard times, no lay-uffs. a.ways your own boss Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply atocks equipment on credit. 200 home peresal ies being experience unnecessary to start Wonderful opportunity to own pleasant. dign field profishe business backed by world-wide industry. Write Rawleigh a, Dept. A U.PSC Freeport II.

MAKE Big Money demonstrating amazing Handyn'an tool 101 uses Fulls posts, roots amail stumps jacks up trucks tractors wagons lifts buildings attractes fences api ces wife toakes rider press dandy auto bumper jack etc. Lifts pout pushes with I ton power. Write Harrah, Dep. Maria Buomfield Ind.

LOCAL Agents wanted to wear and demonstrate suits to friends No canvassers.

Partial payment plan. Up to \$12 in a day,
Experience annecessary Valuable demonstrating equipment actual sanders Free
Progress Tanoring, Dept N 221 500
Throop, Chicago

OOOD 8 deline for printing and advertising salesmen. Detailed mane plates in amail quantities. Great demand. Also make money applying initials on automobiles. Free Bamples. Raico, 1105 Washington S. Bos on Mass.

CALL on Service stations factories restairants, businesses professions with lettered advertising antiforms about work suits, etc. 100 styles. Exclusive features Big advance commissions. Free outfit, Topps Dept. 8-24 Rochester Ind.

OPPORTUNITY Limited number men. Crime-Alarm, Box 21 Bath Beach Sta . Brook on

ENGRAVED name plates number plates, Signs profits large Brett Bros., Elmwood Ave., Winthrop. Mass,

READ CAREFULLY

These Classified Advertisements, under more than 110 classifications, contain a gold-mine of interesting, useful information. Among them you'll find many money-saving and money-making opportunities, new products and services. Make it a habit to read this section every month, it pays.

MAGIC Clother Brush Revolutionary invention Erases deri like magic Sa es directeating Sensal unal seller Samples aent on that Rush name Kristee 121 Akron Ohio

SCHOOL Sen ora -Sell Graduation Carda America's largest fastest seing display 10 Commission Free Carda Universal Englaving & Printing, Box 745-E. Pittabu ab Penna.

AT home your own manufacturing bust hess, making popular \$1.00 novel es Cost you le to 15c Everything supposed Write So Lo Works, Dept. R-4M, Cincinnat. Ohio

AGENTS Opportunity make money book containing it successful business plans have office send for free in roductory bookiet. Ebts Co., 214-A Grand St., New York

OOOD Paying business pitering in from, plating autoparts reflectors becycles between fixtures by late method. Free particulars and proofs. Cummetal Co. A e O Decatur II.

SELL bankrupt clothing bargains from home store auto Shoes for Men a sui a officeast, The dresses 10c, Experience unnecessary Pres wholesale Catalog Superior Jobbing 1250-LA Jefferson Chicago

Will you give us 5% first \$500 you make?
Afternoons free! Work home! \$1 000
month reported (exceptional-fulltime.
Expect surprise! National-3, BX1340, San
Betnardino, Calif

NEW Bensational Push Button controlled gas tank lock Electric operates from dash & d on new Graham Great for Christmas presents. Agents, Dealers, write-locky Scap-Up, Ashland, Er.

SFI I produce of universal appear Prospects e envelope Your own bistress with income governed by your own ability Write promptly Burste Company Orr-

SELL dresses low as \$1.24 Hundreds sensaona bargains Ar oal satepies lifer Send dress a ze age Harford, Dept R-245, Chemna i Oh o

HIGH School Sen ors Make good money selling our Oradus on Name Cards Biggest commission Season starting Hurry! Craffeards Box 215 P. Isburgh

ATTENTION Neu-Gasz costs you \$12.75.
gross Large 50c package Your profit
\$59.25 per gross Write today! Neu-Osus
Co. Omaha, Nebr.

ACENTS—Men a suite Me, pants 23c, Overcours 41c Lad es coute 35c Ormansi 10c aweaters 25c Other barga na Catalog Free Portney 566-Al Roosever, Chicago, PHEE waser and our concentrates make 58 products. We supply labels, bottles, Enormous profits Quasco, P 20030 Russell, Detroit

COIN Cherks Bugs, razor blades trick playing cards et Rush 10c for sample layout Low wholesale prices to agents Devere Nove' y Co. Dept 37 Dayton Obio. YOUR ad in this Classification will reach productive sales getters for your products or services Rates on request Popular Science Classified, 153 Fourth Ave. N.Y.O. AUENTS 100 - Profit seeiing Gold Leaf letters; stores and offices. Free samples, Metalite Letter Co., 437 North Clark, Chicago.

OPERATE steady business restivering murrofs, making chipped gibes nameple se, signs. Write Sprinkie, Plater 910, Marion, and

SILVERWARE instantly cleaned Simply d.p. and dry Amazing demonstration 600 profits SuProcess, Dept 51 Aurors.

LORD'S Prayer, on real pennies—indiv.dually mounted on good-luck cards—Sure winner 86 00 Gross Samples 750 dosen Perkins, 1200 Lawrence, Chicago

WINDOW sign letters, Penny each, Large sizes, New styles. Absolutely beautiful. Processmples Atlas, 7941-R Halsted Chicago PREE sample—amating cleaner, sells homes, taverna everywhere. Big profit fast repeater Beaco, 5009 X, Irving Park, Chicago,

AIR CONDITIONING

FURNACE B overs—\$22.50 up attic blowers cooling blowers and air conditioning blowers -al. sizes Quaranteed Write for literature Reynolds Mir Co. 412 Prospect Ave. N.E. Grand Rapids, Mirch.

ELECTRICAL Decodor ser controls el.m., on es and pur fice all odors quickly A.r. Pur.fice.don. 2526 Grand Ave., Detroit, Mich.

ANTIQUES, RELICS INDIAN GOODS

INDIAS cents Confederate bulk, coing, gema crystals minerals, curve catalog 52 dissirations 50 100 ancient arrowheads 53 00 Temahawk head 500 H Daniel, Hot Springs, Ark

12 BEAUTIFUL Tiny assorted Plint Bird arrowheads \$1.20. Satisfaction Guaranteed, Virginia Curio Shoppe, Blackwater

SWORDS Rapiers Daggers Pisto's Cetalog 10c Robert Abeia, 960 2 Lexington Avenue New York

30 GENUINE Indian Arrowheads \$1 00. Ca and Geo Ho der Orenwood, Ark

ATTHORS' SERVICE

SHORT Stories revised, typewritten maracted Hursh, Box 8-1011 Harrisburg, Penna.

AUTOMOBILES

SAVE your battery Don't let cold weather starting made easy and quick Complete instructions 25c Advance Laboratories, 2112 West 51st, Chicago

THIS is what you have been looking for New mergod Dua, Vacuum Governed Crackcase have Chamber Sludge Pre-ventor Removes all sludge-forming piston blowby vapore from invide of engine before they can condense to water and studge. Combined Top Other No man.ieproof Claranteed Endorsed Fords Funt proof Claranteed Endorsed Fo.det For In ernational Trucks (HD FAB Mitors) OMC (AC Modess Ford 15 Mercury, Dodge Chartolet Plymouth DeSoto Fargo Cive model, Fear if truck or rar 250 Prepaid, Thermo-Hyphan, Miams, Obseptions. Ohushoms

BUPERCHAROERS at 00 O aranteed mileage increase 20%, power 18% University of Detroit test. Any car, give make, year, Wrench installs 15 minutes. John Roary Manufacturer, \$719 Lorane, Detroit Mch.

Detroit. Mich

PROPESSIONAL Midget turne two passenger roads, ers. M dret motorrycae, motoracoolers Quaranteed motors, wheels, parts, plans Handbunk caleing: 90 Historations 70c M. dwest Box 1958 BO, Chicago. GASCILINE saving de ce 50c, Ford 1934-1940; Chevrojet, 1935 1940, Walert Co 3428 Ro. 10th St., Milwaukes, Wis

ACTO SUPPLIES & EQUIPMENT

CONVERT your car to burn Divise oil.

Bere up to 10% fuel costs. Cheep Installation. Wonderful performance, Proven factory melital Different and better Costs nothing to divestigate. Write for free circum no 3. Harring on Company 201-204.

Manchester B dg. Portland Oregon.

PUEL oil conversions for automotive, marine engines. Write for free a exatine. Bouston & Logan, 3113 Addison, Berkeley

Cal form a.

BARGAINS—Welders, compressors, bet-tery chargers, car washers Liberal trial, terms, Write Hobert Equipment, Box P-113, Troy, Ohio

NOITATION

AVIATION wants more Lincoln Trained men for positions as Airline Mechanics, ical impineers, a fritage factory mechanics comments a pilots. This Liocoln Government Approved School of Avanton placing graduates in fine big pay non-ions.

Deporting sea for many more Chartes from 8 weeks to 3 years prepared for immediate on payment. Heasonable tates.

Write Today for information Linion. Aeronautical Institute (Inc.), 2106 Aeronali. Bldg., Lincoln, Nebr.

AIRPLANE and engine mechanics book, 1840 ed tion prepares for government examinations, 63 90 postpaid or C O D. Quis System, 1635 Plower St., Glendale, Calif

AVIATION Apprentices. Airminded Young
Men interested in Technical training
for entering Aviation as Apprentices see ad
on page 43.

AVIATION Blueprint Reading Course Bend 3c Postage for information, Baltimore School of Aviation, Box 13, Hamilton Sta., Balumore, Md.

PROPELLERS, All types Catalog for Banks Propeller Co., Love Field, Delies,

AIRCOOLED Ford, Powerful Aircraft, Snows.ed engines, 842.50, Conversion, 839.50 Lightning Aircraft, St. Paul, M.nn. OAR motor power airplane cala or 6c. Polk's 429 Seventh Ave. New York

LEARN to fir free Polder dime Chmeyer,

Box 1918 Hemps and N h

BATTERIES, GENERATORS, ETC.

KINISON lifetime storage batteries for light and nower Eliminate acid battery dis-cases Long guaran ee All hinds rebuilt generaling plants moura and noise ansour afticles at hargan prices Free inter-esting literature, W. Hawley Smith Com-pany, Oroton Palls, N. Y.

GENUINE Edison Batterles for power light. Non-acid. Fifteen year alle Five year uncombit onal guaranteed. Low prices Complete lighting plants. Pres literative, See Jay Company 37 Sterling Ave. You-kers, New York.

RELEPRINTS & PLANS

100 TELUHOW Plans, Explained Simple; Useful, Interesting For Rometrafters of all Ages List, 10 cts. Charles A, King, E. Ruigs on, N. H.

MOATS, OUTBOARD MOTORS, ETC. OUTBOARD Motors Used and Rebut to Bars money Used parts Barga n list free Crandall-Hicks, \$55 Commonwealth. Boston, Mass,

FULL size, cut-to-shape Book patterns, hideprints and spec heattons, Big mice-tion Bargains Send for cours for illustrated catalog Book How to finid Box a . 81 00 postpaid Chresand Boat Blueprins Cu S at an A 77 Cleveland Ohio

MARINE Power Ranly convert any Ford motor (domestic and foreign) to h Osco Parts and K to Complete Catalogue 25c (com) Ostu haton, 3448-P Lawrence St., Philadelphia Pa

MARINE Conversion Parts for all auto engres Buy here and save Conversion Far a Co. 271 Adams St. Busion Mass

RAVAKS Outboards Rouboats Dick Bosts Weldsnod reads out kins Catalog I. C. e Craft Ross, M. Ibern N. J.

BODY BUILDING COURSES.

COMPLETE Course to Body Culture explains simple rules for sound health.
Only \$1.90 postpaid, with Pree Copy of 12 exercises from the \$35 English Height Increase and Stretching Course, Setisfaction guaranteed or money refunded. Olympic Statem Waterville Maine

EXERCISE equipment, courses. Special offers' Free bookiet Good Barbai Co., Dept. 5, Reading, Pt.

"TOPS in Results—"

We have been consistently advertising in your classified section and we expect to conflave our copy or long as we are in the mail order hosiness, No need to keep constant check on results from Popular Science -we always KNOW It is TOPS de Results (

> G. E. Hendrickson, Three-M Service Argyle, Wisconsin

BOOKS, PERIODICALS

EXCELLENT Sparetime profits taking subscriptions 2500 mages res. Agents confidential catalogue complete statiogue supplies Pree Dept 17, Pinto, 503 Montre Brooking N Y

DIVE Diary—Delute illustrated privately published Originally \$6.00 New only \$2.00 Economy Edition, \$1.00 Refused guarantee Poets Corner Press, Patitades

Sc BUYS back dated magazines. Domestic Poreign Art 100 000 used new bioks Cataion 10c (refunded) Cicerone a, 863(8) First Ave. New York City

LIGHTNING Shorthand militaught Sc. Typews ling of in 19hi 75c. 54 pages each Both 60c postpaid, Culton Company McK nows, Texas.

SENSATIONAL Mexican C ban Art Pictures, books, miscellaneous, Sample, Lists 50c Jordanari Cedaras, 188, Br.; on PRIE Christinas Book Catalogue Write Old Prof s Book Shop. 515 Arcadia Ck. Pontlac, Mich

SNAPPY books, pictures nose ties etc. Where to get We teil you list only 25c Esse 5000- A Cordelin Ave. Baltimore Md. PHETTY Gall art photos, books hove , on Braun, 153 W 47th Chicago

PHOTOGRAPHS Listings and Sample De. McCloldrick, Manafield, Mass, Attort B.

BUILD LE LOURSELL

BUTTO your own machine tools, Equip your shop at big savings We furnish that the materials, blue prints for mining machine, ahaper hand new and 21 other metals and woodworking tools, Send 10c for new 1941, 32-page, illustrated catalog Lewis Machine Tool Co. Dept. 8-10, Box 114. Station A, Los Angeles, MOTORSCOOTERS Midget care Pagite but the Complete blank and hierature on

horst Complete plans and literature up where a tires, motors transmissions cutches, etc. 10c Houseker, Mason.own,

BUILD power Scooters, midget cars Pupply tires wheels, motors Lowest prices Send 100 for plans etc Bild Ut-Own Devices, Dept., 1B, 536 Sorth Parkside, Chicago.

MIDGETS -- Racers -- Motorscooters Build now while prices lowest. Catalog finest plans, parts, building kits, 10c. New list 100 used motors, midgets, parts, 20c. Shippe Midgets, Box 543 E. Zanesville, Ohio,

BUSINESS OPPORTUNITIES

PLASTEX Industries offer andustrious men an opportunit to start a business of their own, manufacturing art goods novelifes and utility products in Plantex and marble imitation. Jec material makes regular for store seller. Rubber much furth shed for speed production. Small investigation by the character of the control of the character tactuters Ambitious men have chance for rest prosper, y Planten Industries, Dept. 8 1935 Washington Ave. New York, N. Y.

BUILD your own Business Popular Science Classified Ada will Introduce your prodnets and over 400,000 homes every month. These small ada have built big hav names for many here are no in the mail order field Rend us a de cription of your products. We will prepare advertisements and case Adv Dept Popular Scie re Month-15 153 B Fourth A v New York.

MEN now on leg on farmers poultry tailors Maierially increase your income takers Maiertall's increase your invente take g orders for hig Boy Cricks. America's Philest. Pull or part time basis, Backed by extens so National advertising Reserviced territory franchise int udes the famous Big Bon Chuck Basing Pian Get delang immediately lilinois State Hatcheries. 206 Jefferson Springfield. III

IF you flave some space room where you can do light work, we can offer you a profita-ble proposition caving Xmas goods, 5 and loc note that, sabitage, lay as on ste for firm of many years standing No experience necessary as we furnish ful instructions with moulds Spare or full time For details write: Metal Cast Products Co Dept. E. 1886 Boston Road, New York City

FTART home business making statuary, paques art goods novel les, source es, concrete pottery garden furnilure art ficial marble ficoring liquid marble blake your own firstble molds. Assaurag profits, Valuable folder free, Creative Publishers, P. B. | Gleacoe, I)1.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique not pens) as thing schemes. Free de-tails. Helson Co., 100 Bherman, Dept. so" A Ch. ago

COLOR Correct with themself Bluccotook Cement Artistry Wahing wells,
Spin concrete pottery Benches. Oarden
Ornaments, Cold-glass, concrete-pain a,
marbling Bample 100 Hollywood CementCivil 3010 Wonderland, Hollywood, Calif.

INVENTORS Patent your invention Se-ture book et 'St w to Protect Your In-ven on No obligation McMorrow and Berman Registe ed Patent Attorneys, 163 G Barris er Bidg Wastington D C MEN Women operate 'Specially Candy Partory bome Ail or apare time Op-per unity for attedy in one (Our 32nd, rear; Bookset free Ragidale Candles, Drawer is East Orange, N. J.

Will you give on \$. first \$600 you make?
Afternoons free! Work home! \$1,000
month reported (exceptional -- fultime)
Expert a reprise! National-4, BX1200, San Bernardino Calif.

MAII, Order spars-time or full time bun-ness enterprise. Gather "edit" and sell names for advertisers. Details Pres. O. N. Schroeder, 36 West Washington, Chicago,

START profitable bome business manufacturing Scapiess Suds Amazing dis-covery E' feinates hard acrubbing Coals in quart Formula, sample 25c. Details iree. Linothex, 1400d Colt, Clevaland

GOOD Pay og Buy best a vering Burrors, bit room fix area by inte method. Free perticulars and proofs. Ounmetal Co., Ave E. Decatur, Ill.

ADD to your income this wanter! Orow mushrooms in spare time in cellar, shed, garage We buy all you raise and furnish materials. Write today for big. Free Book United, 3848-AE Lingoin Ave., Chicago. ENORMOUS profit possibilities, Sail by ma. Your own but heat Q- rk profits. 120 monet-making plant Form, as Full parts of are Free Monarch Publications, 715H Haas Bidg Los Angeles.

PRES 500 cener manorder homework, local business, agency offers—all anappy miner-makers, Lewis Do., \$25-A Carpen-

ter Oak Park, Ili,

MARE your Mail Order Business Pay' Cor' ge uine original letters of Mail Order Bisers. Particulars Free Crown Mail Order 1848P Monton St. Hem York

FOR Free Information concerning an extreme v profitable lifetime business, write (nie Association, Syracuse, M. Y Immedia ely

SWISS Music Box works-\$1.26 to \$2.10. Shitable for many novelties, Mermod Manufacturers, 147 West 66th St., New York

17) WAYS to make money in home or office, business of your swin Fun po-ticulars fire Elite Co., 314-A Grand St., New York

three Pormules Processes Accurate and user Co stop Proc P Thanks Co Mar gloss D C

MARE color-guided concrete potters gravelones than flours un in Bandflori, wair proofing stc Book et, Ir stamp Na ional Pot grees Minneape, a Minn

Liut 'D marke An we can make Brushed, sprayed, moided' Colorful, glased, Particulars free, Marbieleing Service, Edwardsville, III.

WORK already done for you, Publish interestime, profitable mail order magatine flan ple mail-ractions sie De Thrber, Pub e et R. J. Freedom, Maine

PREE literature describing many moneymaking plans, A. Plury, 1862 Locust, Des Moines, Iowa.

MAILORDYR Directory 300 Bress Sixted 31 class Scations like Einst Publications, Syractise, M. T

PILING Saws easy this new way One dollar hour easy. 25c brings instructions, Harney Pickett, Garden City, Iowa.

T "18TS—We can use your spare time Details stamp. Richmond Service, \$64-54 Broadway, Sterling, Ill

MOME Business, Pros Sterature shows way Vosacet Press, 1634-6A Menroe Chicago

TURN Tin came into money instruct one 25c. Chancy, 1130 E. 16th St., Jackson-

MOW and where to obtain capetal Particulars free, Star Service, Wapakenets, One

MALL and date to be eter or wonde for opportunity Miracle Pactories, Comshohocken Pa.

INVENTION Finance Magazine 30-N Wall Street, New York For lavonters Free part ou are

R BHER Mold making Pinater on ing 2ra actions 26c Kemitan, 178, Park vider 2

WHITHE to buy at lewest emplessie prices for free free Yorens. But 36 313.

MAINE Canary Burds for us Catalogue information IDC Houck s, Dept 6 Tolko. Ohio

Batt by Man Richa posellies barge on Barge on Linea. Can Sur P. We a L'h ago

CANH for \$4 page beat 200 enter prof.
makers but the trace are the paid one
Worse no 202 West 20 h H mand. Much
MAKE door mats from tires. Profits and
anteed. Instructions \$3.00. Thomas Kanot 5 *2 Mc Car Detroit, Mich

UNI St AL Oppus up y Auto radio Sperie sets sets \$1.00 hourly. Write 3v2

RAINE Angora Rubbits-Wool brings \$5.00 pc rd Particulars Firm Orderland a Carr on 1

INT PPENDENT Operator Protess 4 a ma, solder magazine 10c Erat. Publication a Bracuse S V

MOLD making, plaster casting, Poolproof rubber. 24 page instructly catalogue free Plastic's, 711 Wesly Muncle, Ind. BANDY men. Earn money home operating

Community Fix-it Shop Mafford 108 Rawlings, Carbondale, Illi
RECAST old batteries into new Latest acts exements. Be see Laboratories St.

Paul. Monn OREAT Money-Making upportunities! Vacent Service 313 Washington Moneyen

CONVERT tin cans into steel scrap. 's in bie tin Two processes 50c Harry D Cater 1601 East 16th Ave. Denver Colo. STEADY Home Business. Whole plan 50c. haunders, Forest Olen, Md.

100 MONEYMAKERS—66 pages, no advertusements—25c. Kraft Publications, Syracuse. N. Y.

MAKE genuine rubber molds Details free, June, 101 A Beech, Holyoke, Mass.

MAKE extra money with salesboards, Write Johnson's, Box 1562, Baltimore

BUSINESS SERVICE

1 000 ORIGINAL letters—Agents and mail order buyers—\$4.00. Particulars Fire. Grown Mail Order, 164-PS Mearce St., New York.

CAMERAS, PHOTO SI PPLIES

POLLOW the ship of briefs who for 30 years have been a long Base for camera bargains of 3 or major Used Circ Rodali B. F.13 letts \$22 to Brought Meganist F.15 letts \$22 to Brought Meganist F.15 letts \$750 F to 75 F.35 letts, \$1150 Foth Derby F.35 letts \$1250 Voig lander Bessa rangeficter compact. F.15 letts Compar Rapid shotter \$48.50 Thou bands of integrals lated in free Base Bargaingram No. 242 Buil Cameras No. 245 Circ Cameras Write for turn copy Money back guarantee. Base Camera Company, Dept. BP, 275 West Madisan Bt., Chicagh, Inc.

JUST word name and address. They you re on our man is as to receive Free our monthly Bargain. But of his assuming read and equipment We but sell or entrange and equipment We but sell or entrange ame aberta trade the on cameras must aling tumophs guns etc. Ash about our desy pa me plan cleurge Letine & Bons. IAA Cut h. I. It would Mana

Off reloring pla igraphs a fastinating hisby or profit able business. Let make home Rany son, thed mented for free independence and send for free information and let terretts. National Art Falls Sent M. highe coops. 142 f. ago. 621 EU O-COPY groundglass focus ng attachment for trick as differ the state. D. Paul Shall Dopt. Paul 248

CANDID Camera owners can now reload their 15MM apools in darlight Bend for r mar W W 15-40 Co Box 3 100, dalom

MAKE money in sho ography learn que's achame has pun Pre cua effecte de un exemat). Common articol adult in su'll and interes ing bossies and fee American Sc soil of Pisc ography 2002 Michigan Ave., Dept 1742 Chicago.

Ave Dayton Orio

Files? come fire served 200 clevese brass. Progs Drivers in differ \$2.55 Coming to 5. Pay not man \$300 plus postage \$400 Selen 264 Colon by the Brasilian No. 3

CAMERA Repairing Bellows made to proder about an repaired Bellows made to fit all a ancard cameras. In ed Camera Co. Inc. B 15.5 Bermont C. scago.

ENT ARCIER \$1.50 En a gen eight fieren a se uf Ameri nega tren. Gra an end Paramo it Bases Computsy 80 Dudsey B. Bising Mase

ART Was glamorous Hollywood art as a models Eight \$27" stills \$1.00. Holly wood Art Supply Company, Ben 607-2

20% TO 40% discount on films, paper, still or mone cameras. Write Paramount Co 32 Ph East 22nd St. New York

CAPITAL RAISING

WE show you how to obtain one tal for your business, how to protect and r arket your invention. Write Enterprise Eurosa, Syracuse, N. T.

CARTOONING SIGN PAINTING, DRAWING AIDS

HALF your own money making hunters. Leath then card or the rich part of Write for details, Begier Specialty 1472PH Broadway New York. SIGNWEITING in coar and profitable, Set of the local Modern Sugara and Supposed Showcarder, \$22 M Fruit, San Pau, Many

AMATRUR Cartoonists, term stendy income copying on Joon for advertisers. Adversice A 2)18 Wilcons.

ART Magazine lists art books—free! Send.
13c per age A i Readquarters, West.
Docv. Mad in Wiscons

(HALK TALK STUNTS

LACOM preducing program, \$1.80, Singtra ed ca sing loc Cartesmast Baida, On Aunti, Wint

CHARTERS

DELAWARE charters; complete service \$35.00. Submitted forms. Chas. C., Guyer, Inc., Wilmington, Del.

CHEMICALS & APPARATUS

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and experimental laboratories. Complete supply service for students taking correspondence actuois themistry courses. Bend 3c postage for free 44 page catalog Dept M26, Stological Supply Co., \$176 Mt. Mose Ave., Rochester N Y

MANUBOOK for Chemical Esperimenters, illustrated, hundreds of experiments, see Experiment buoklet, lie Chemical on a ogue to Reading Scientific Company, Reading Found

FREE co-mage cotalog of chemical and above tory supplies for amateur chemists. Wollengar successores and supplies, scientific books at big discount. J. O. Wins. Dept. J. C. 124 West 13 Street. N. Y. C. PREE Chemistry cotalog Supplies at Scientific complete laboratory. Remixtances for Corporation, 1918 Science St., P. oc.4. D. N. Y.

LUMINOUS Parts Ose in your home will glow in dark. Agospes 're low, red, violet, blue, Fairmount Chemical Co., 126 Liberty St., New York Ci ;

PROFE Ca alogue Chematry of neckings, by ogn for receipes, lessection Transp Labora octon Evass on Dr.

CHEMICAL Magazine Research, experiments, magic Sample 16c, Waltman, 196 Broadway, New York,

CATALOG 3000 Illustrations 10 000 prices. Bent for 500 Laboratory Materials, 7317 Vincendes, Chicago,

CHEMICALS in he quantities Catalog le Plescher s Laboratories. Medic d Man.

DETECTIVES

DETECTIVES-Work home-travel Experience unnecessary Write, Wagoner, 2640-P Broadway New York

BECOME a detective Opportu. Sy to early oblide sears of Pres de ective particulate. Raymond R of a 20 - 1, 6

DOUGH, BIRLING, PRINS

PUPPIER all hinds free details Brook los phoens recommed breeds described like Rolls. Kristen Chary H V ALLICATOR, St 2h Chameleon 25c Catabride Quivirg Specialties Co. Watfield, Kanada

FOUCATIONAL & INSTRUCTION

REAL, jobs open—Equip yourself by learning auto, these, aviation mechanics, welding body & funder, quickly! Real Opportunity for real Job. Write nearest school for low tuition raiss. Information Pres, Dept & 1 Mcswerny, Detroit, Michigan, or Katasa City Mo

MEN Wan ed A to Diesei Mechanics Wa par your to froad fare to Nash to Let on trate you so be an expert mechanic and help rou get a good to The coar to you is small. For free booklet we to Kashville As a Diesel School, Dept. 260 Blashville, Tenn

COMRESPONDENCE courses and educations books angle is and flood Rected. Exchanged Al subjects Satisfaction guaraaned Cash paid for used to rese Complete details and baryon to sing free for to Nelson Company 100 Sharman, Dept. A 2 I Lineary

Will lo Not there is Are Learn quickly by as a practicen Mabert Weider, School Ind. Id a martine for the at bore root of mare at used Me in stamps by an in about weiding lessons post paid and full particulars Hobert Welding School, Box F-114, Troy Ohio

Carter-D, 1107 N Mayfield, Chicago,

REW opportunition in Air Conditioning
Electric Refrigers 7 and As a BudyFreder inc. Lag Me of Work weld ig
pointing Many trained Men mire up to
136-450 weekly Start preparing now Get
Free facts, Utilities Engineering Institute,
1314 Beiden, Depk. 311 Chicago

S B Gov t jebe pay up in bit a neek to start. Oot touds for next exame na with The way has as I tal carrier that ca er within he p and o here I so bush tells how you that has I'v W o q . It Pa erion to hoot Douc P R R chee er H Y

USED Correspondence Chartes and whats Monay-back guarantee W a for tree and slog listing 4000 but a na Coought.) Les Mountain Frank Au

Talegran Opport up es now ave table to beginners due to new inrend ret rement act. Expenses him Ca a log Pres Budge's Institute Marmon St., Va paramo 1 4

CLINICAL Laboratory Technic to ght in y ar can home Practice outfit supplied. Bullet et from Traperte Tuchnical Institute,

Claim Ad as no Excelent pay to verte gale tragge accidents. Ares outwit fraudwient claiments. Burne School, 311 More-wood, Pitteburgh, Pa

E Government Jobs \$106 \$175 month Try nest esam no Fit I John Del-ticulars Pres Frankish Institute Dept. LIA Rechester W Y

DRAFTSMEN Wented! Big-pay jobs Train of home fimp, ed third it helpe i Technology, Greenvale, Ohio

DRAFTS WEN Increase name in sector tory instruction 25c Drattamen a Posto-dation, West Medford, Mass.

USED Correspondence courses, books, Bold recited to got (a sing free Cul on Co M K nree 1988)

INSURANCE Agency Accounting only \$2.00. Details Pree. B E. White, 704

\$2.00. Details Free. R. South Spring, Los Angeles

BLECTRICAL BUPPLIER & EQUIP

AT THURATING Correct bargains 1, Horse 3636 appeal repuis on relation itse re 8.75 500 trait a erica rig girlera re 73.56 Butter Steetrac 1866 Missionauses.

BEATTH Lamp Dual for U tra Woods.
Infra Red AC DC Bin Fan Ville a
"D \$1 90 postum d Reput Mig 46.5 C
Cottage Or a Chinage

FLI ORFRE ENT AC Descript highting for seek offer winders home Lutest sen-est on him Discount literature Pres. Missee Rad of E 33 Kansas City, Mo

Rite Thur Per . D . B . Te . \$2 15. Wheissain Pruce. Hates Corners. W in

ELECTRIC Pencil. Writes-Engraves all me air \$1 to pur paid Bayer Mig., 4525-C. Cot age Grove Chang.

PARTIUS E reks vacuum cleaner spoi

FLECTRICIANS Make short detector Plans \$1 00 Write 161-P Parmland, Ind.

ENGINES, MOTORS, ETC.

BARGAIN I, RP rebuilt motors, 00 cycle. I place 1.0 volt, 3600 rpm like new guaranteed \$4.25 Send check to Eric Riccirio Motor Co., 131 Church St., Bul-leio. N. Y.

ELLUSTRATED bargain pricefet. Motors grinders; drills, Complete ; ora Hume Workshop tools, Manlorder Ricetric, 726 South Dearborn, Chicago

AUTERNATING, 15 herse, 116 volt induc-tion motors, Rebuilt, guaranteed \$1.25 Wilmot Aute Supply, 2347 St. Paul Ave Chicago.

ATR Compressors 13,x13, 26,00; 2x2 27 00 25x2 \$2 00 Electric drills is in, 26 05 Prec Poider Battemas, 1915 & State Chi-CARO

LARCIATION Welders electropisting mo-lor generators, guaranteed, liberal terms. Write Hobarts, Box F-115, Troy, Ohio,

MOTOR Wind as shall be seen by MOTOM Bon 7831 Kanasa v Mo

PARMS OTHER REAL ESTATE

66 ACRES near White H ver un mproved poultry land \$175 \$3 down to menth y Pres sist and a stature Hubbard, 266 Orseeman Bidg Kansas City Kon. Monatora Men Paris, Land Washington, Municipal Men and Idaha Oregon North Dan in Dependable to ups factor of conste We for hieracure out of tight a barga as Specify state J. W. Haw. 130 Herter, Fo. 5. Rr. 56 Fab. M. 5.

ONOVE & Home facing Golf 1 on 110 brenges de g apele : un pared hwas breng s era of water 5 rms eses de ba ? 2 ar garage was \$2770 terms pg 50 C aupplement & big Free calls og Birotal Realty 255 725 4 g Ave Whit

FILLDGLASSES, TELESCOPES A Mile heapte combine

THE ESCOPES, Everything for the amateur a second Kits \$3.50 up, Merrica prisms or see Serid He for catalog Asset Han Telescope Laboratorim, In-Hollywood Bivd., Hollywood, Calif. Inc . 3010

THE RECEIPTED 16 extenopes I not users be gain cataing ree Brownscope Co.

FOR INVESTORS

INVENTORS Take first step toward protecting your invention—without ob. gation flend today for free 'Record of Inter' on form and new Free 'Patent
(I de fer the ir en'er con aiming in
et'er ions on here to patent and sell in
the seas dir a a of much service con
terior, payment plan Bute forst Car
eric A O bisen Regis red Palent At
turney LAJA Adems Bodg Washington.

SEVERAL How transferred we recto by the eviced have been on end, a pieced by New terms needed | once manufactured on coopers its busin We design and de e. p. roul invention strain paten a manufacture tools des than at We special as in plantics Write for Iree at malan, R. & & E sincering Co., Dept. EW-1, IT East 47: d. R., New York City.

PATRICT year dea New groful ideas often two tellucide Two box to free tell how to apply for pa ent protection g was basic ways to sen your invention PATRET your dea New u-eful ideas Experienced patent counselers. From rea-somable, deferred payments. Write today V for J Evans & Co 432 A V tor Bidg Pept rea-

INS PRETENDS! Unpatented inventions complately producted at total cost \$1.50 Show
we lable ideas to prospective buyers safegraded are not live! Also protests School
Short ato, as School of Prince ton Page
Moroney 322--52nd St. Bross o N. Y.

INVENTIONAL A compare a na soral pers of Pa ent see has a sidely drawing as property of the compare altered as a road Write for the booker. There age for Prof. Camera 1 to a of invention. Camera Bidg. Grand Ray, do Mach. INVENTIONAL Consented inventions now.

re able with positive cafeguards uniter parent laws. Here low our proceeds a Complete details free American Parent a Corporation Dept 12 Washington, II C

Will teente huvers meritarione pa ented union erted proette in If a If set, reply maned arely Dearr stree bookiet, references free Internal Reputter 3A-236 Smath Parked Chicago

DEVENTORS Send for free mov to 72page bunk on paten a Bruteriab e territo Prompt act on for Sder al personal sets on L. F. Randnipa, Dept 766, Washington D. C.

PREE to inventors. An amoting both abich gives invide on inventors for prof. We cost. No obligation. Comments tool Co. Dept. PSS SA Cust made Of a

NATE you a sound practical invention for ease parented or arpatement's American Inventors, Dept 3-A, Washington, D. C. PATENT Information Gratis. No booklets, Personal Service, horsest opinions Raiph

CASH for practical ideas and inventions. Mr Salt 23 5641 Press. Change

FORMULAS, PLANS, ETC.

WILL god v he p with any chem at prod uct of problem Formulae C. Cherris Son 's Clarmon Dela CHISOL LAND

THAKLY Pormulas for successful prod-Therit Commany Washington D C

PORMULAS-Latest, best, Analysis, Litera ure free. & Belfert, Engineering Hide

#INGLE-Ingredient Permulas Interesting information free, C, Kinford, Wayne,

PURSEULAS AT hinds Guaranteed Cat-

HELP WANTED

MEN and women wanted to raise mushrooms at home this a n or in reuser alled. En age No experience recementy We fur-nish major as and pay cash for all you failed (Corrustry refer shed you W to locay for Five Book, United, 3048-AF Lin-cound of County

MICHGRADE BALESMEY

ADVERTISING Book Matching offer ? berall the special state of the series of the serie

Butte da e profus ICe a Cast bonuses, represent large manufacturar affice de lored et e a neckular ha ert anderwear direct to wee or Exha de see outfit free Write Tell us some n. g about yourself Packard Corperation. Dept F-4M, Terro Hauta, Ind

EVERY Business must buy Printing adv specialties: book matches, etc. Taxe or-flers for he proceed the 1808 consisty came at 50 price earling Free desig 50% adds cod from but us Exp. attree Offitil free David Liver Press, 313 to Hatte-Stan Den 4. C' sen

MAKE more stoney with Red Comet fire control products Low prices. Proved seven years, Splendid sales outfit free Bome good territory open. Exclusive Write quick. 744 Red Comet Building, Litturton, Cole.

tory prices Postpaid. Acq Biades. Buf-

HOME CHAPTNERS

22 t AWW Ornsment patterns 250, Other put even th 20 h gh leart gri Durch bin preve b 1 terries Mexica gri, Mexican boy, dwarf, penguin, flower girl, 10c each, 3 for 25c. 25 novelty patterns 30c. All 56 full size patterns \$1.00 pusips.d Strother, Box 383-BU Belington, W ha

CHRISTIR tubular steel tuble legs make bee in, p o de c'ables Log sets for all types, Make your own top from wide variety of materials Bend dime for lists and print a E united Products to \$27 Laborance Ave. Eliwood City, Pa

MEXICAN Wood novelther easily made! 30 patterns, complete instructions 25c 20 Cowboy silhouette patterns 25c, 10 iswa or amont pe terns 15c Mos Arteralia. Engle Pass Texas

OFT Pres Leathercraft Instruction pamphlets, prices of lenthers, tools, projects. Make entra money—sifts Lenther samples W der & Co 1834 Cresby, Dopt, A-1,

LEATHERCHAFTSMEN Bend 10c for new handbook and estalogue of tools and supplies. E. A. Sweet Company, Inc., Leathercraft Div., 8-7, 143 State St., Mingbamton N

m PATTERNS 30 have occaments, 20 silhouette, 26 noveltes, 30 laws ornaments, 30c each set, all for \$1.00, Madorn Woodcraft, Saginaw, Mich

RUBBER mold kit, \$1 00 Consists of subberfies, casting nompound, model, Full fire serious John Clark, \$450 Webb Ave., the re. Mich.

VENETIAN blinds, supplies, machinery; shows in the or of the Manufa rad booket 5, 66 Staberts, Bon Me., Glaversville, N. Y.

PATTERN Cutake Snely illustrating No plywood Noveltins, silhouettes, lawn ar-hamen a Decal transfer decorations Also mit et liner. Wu Mr. Shop Anibarn Ge

ENOCKDOWN Order chest, lumber, ve-nette Libertared Careleg let Other Rendall Co., Decatur, Ale.

FREE Faries Pr. v. Lat. samples 25g Big 3625Y Washington D. C.

INVENTIONS WANTED

WANTED-Meriterious patented, unput-ented inventions. Booklet, references, free Invention Reporter, 38-11236 South Pairfield, Chicago

MIGHEST Cash prices for patented and impatented inventions. Shupita Mig. Co., Branch, Wisconsin.

SIMPLE, practical inventions wanted by mapulactu era, parented of trans en ed. Por information w is Chartered Inst. e. of American Inventors, Dupt. 3-C Wash-Ing'an DC

BMALL invertions wanted by many ac-We be for free circular B Hud, 7620 M Fire of Ave. Correspond Ohio.

INVENTIONS sold Patented, impatented. Guaranteed service. Details free, Echrer, 831-32nd Ave. Seat le.

PATENTS, Inventions, sold manufactured, financed, Perrin Co., 400 Fontiac Bank, Pontiac, Mich

INVENTION Pleance Magazine se pi Wall Street, New York, For inventors. Pree particulars

INVENTIONS Promoted. Patented or un-patented. Write Adam Pisher Co., 183-A. Enright. St. Louis, Mo.

CAB'll for Inventions Paten ed of unpatented. Mr Ball, BC-9441 Pleasant, Con-

INVENTIONS Wanted Carb or Rively (burn Enterprises, Dept. B. 2309 Out. tines a) Hidg Los Angeles, Calif

LEGAL DIRECTORY

A or Atty 1736 Figure Texas Cocke.

MACHINERY TOOLS & STPPLLES

WOODWURKERS compliate this saw drill press, shaper, sander motor, acressories \$25, Circular Je, Catalog 10c Machine Service, Newtane, Vermont

DRILL Orinding attachment, price \$7 15 "-Used with bench grinder Literature request, Dealers, Salesmen, Wanted. on request, Dealers, Salesmen Tractor Lite Co., Sidney, Iowa

COMPRESSORS twin crimiters \$4.00 Motors \$5.35. Electric Detlia 30.50 Del North Pifth. Philadelphia

thread wires Shibles Dauge Co. His tl, New Konsington, Penna

MAGTO TRICKS, PUZZEKA. JOKER NOVELTIES

TRICKS you can do! For pocket-parling alage. With coins, cards, clearets, ropes, be a thimbles, watches! Escapes mind-reading, spirit and mantal magic! Illustons, magical books and stage supplies! Largest assortiment lowest prices! 100 page Cataling 500 popular tricks are 100 page of a light books tage magic 100 Write oder Lice living as his non A ! Devise Trans.

MOUSE of 1810 Mys eries Professional magic thop.

WORLD 8 largest professional magic shop.

WORLD & largest professional magic shop Reeps you in touch with latest tricks. To receive man has need No for 1940 catalog H ideas P 230 W about 8 New York

HOLLY WOOD Special' Mag. and be not called gloud to union and free trick for a sec Mag. House of Charges Man 16665 Hot. ly would Co !

TRICKS and Joker's Novelton Catalog and same a Sa Ene-Jay Scie-D Water throp Change

MACICIANS Nesdquarters 2 4 page cats but to 25c Kanter a, 1311 Webnut, Physical dept a

LEARY Magici Join Magicians' Proternity! M not magazine, sample, 10c Interna-tional Magicaus, Mt. Morris, II.

It I PER HATRIA November Co assess and Cleft

MANUFACTURING

INVENTIONS Manutac gred in any quint to pint now contiller old exceloration from table company. No bisnoises allowise a d'ampings metal apec a es dies mode a est Free est ma ce Proc cala og C esced Toos Co Dept PSY BA C resident. Os e INVENTIONS developed and manufacturad Send to rour ideas Modes Engineer-ing Organd, I d. MINERALE & PRECIPIT'S STONES

MINERAL Identification Suspited* Classic

Chemical merhiods Price 33 50 O C Squab Dept. P. Bell, Culf.

CUT and Potath gema Blest and most complete instructions ever pub shed Hand book for Amateur Lapidary P re 22 00 postpaid J H Howard 504 Crescent Ave Greenville, S. C. 50 CHOICE Minerals in sturdy, cloth cov-ered carron, \$2.25 First varieting said minerals for same Parts, Mineral Mast 5 Reducts A. r. Long Beach, Ca. f.

tir MS Agates, Minerals, 20 rough grea-siones inc iding Sapph res. Gartie a etc. \$1.00 th alog free, Hill, Moute 7-K. Rollery Circle of

MINERAL Specimens and bucks or miner-The Gen Step Box 1771 He ena M. 1 ann

SCOTT'S Rose Quarts Co., Custer, Bo. Dak Black Hills Specimens Send Stemp p 2 1

HUNDREDS of fine minerals for collectors. Catalog Sc Scott Lewis, 2500 Beachwood Dr. Hot word Ca.

MISCELL ANDOUS

CORRESPONDENCE courses and educa-tional books, slightly used. Sold. Res. ed Exchanged All subjects. Satisfaction guar-anteed Cash paid for used guarses. Comp ete details and bargain catalog Free. write Newton Company, 100 Sherman, Dept. A 204. Chicago.

LOADSTONE 6th and 1th Books of Moses, 7 Keys to Power, \$1.90 each, Postage extra if C O D Trick Dice, white and black magic books, oils, powders, etc Catalog Free Smythe Co Newark, Mo.

OPPICIAL Airling baggage stickers Ameri-can-Canadian Colonial-Eastern Northwest. TWA 1 tee Write adap of parket At 10 Yart of no New York

DRCC Sin It is appearable, a police of ma sed d = 3 by n statest or Send for free ma l order co assa saving 75% Mart Order Dept 54, Son 231, Mamaton,

Lat HTNING Fast Struct had design charts. for at his er a need engineers. So, Parfor at his er a and engineers. See Pur-ticulate Se. Telestebrok, 66 Court, Brook lon, N. Y.

BI AT K Walnut Cracker bushel hourly Cumpust d severage Sc er ... alle conpart Charky Nut Cracker, Harristoney Pa-Birelis ST Prices for used Cameras M croscopes higoculars, drawing sets 1 was write G Des 1 162 % Mad wn C . ago REVEALING Book H w to Awar A Pertier a Mird. Com ufrie bigte press reture 1 to M. Lable or Chicago.

RPV 213 E gigan ic ma le magas nes sampus Ye r name in elimentos mas al Park a crause him to sea a busied tiens are and insperals. Platet Labora-tors. Paid A o Card.

THRILLING Novelt es ture books photos Big assortment \$1.00 Catalog ate E G

that Name may Pepterbury etc. 25c had Na prive stemp 1104 Natalit. Pa Dr Trus III

Profe Others May Philars Man PINE qual a perf me in his type a dram for the 2 times. Where C. F. on, Arthur a HAVE Pun-Save Money Ho and and marine 215 to Pieck's Watten Other

MODELS & MODEL SUPPLIES

BEAUTIFY ". Bhip & Coach models. Pinest Gus y Redw nd h- He mapie y shipped and hished Ki a complete to a lide a ca Ma himer and many misers \$4.50 Cm. in I you \$6.00 Asso amaler middle a at \$100. her d It's amp for ca aby M nasture ship. M del Dept N. Perhaser Pa.

POWER Models, steam, gasoline, electric, for railways, ships, Metals accessories 84 page Catalog Mc, Charles Cole, Ventura, Col.

ZOOM Model K.ta. airpanne, bonts, ruc-ers, gaz motors, Complete stock-send ers, gaz motors, Complete stock-send 10c for big catalogs, Box 617 Dayton Otno

EN - ME Cataing or car light a pp set life. Rouarden P 24.7 Borth Assuand, Chi-

THOUSANIS ship fittings, hendred kits, calking the, Polk s. 428 Seventh Ave. New York.

STEAM Locomotive with alcohol burner \$7.50 portpard Cn alogue 25c Staum.

BRASS gears and model supplies. Catalog is Pierce Model Works Tinley Park. Ill. RAILROAD Model Shop, Dept. Pt. Dunctien, New Jersey, Catalog 18 cents.

MONEY MARING OPPORTUNITIES.

THIS Ad gets attention! So will yours-if Added cost is low? For de'a a wine to Classified Adv. Mgr., Popular ficience Monthly, New York, E. Y.

Bit a professional seraphoniur. Big fees. Unlimited opportunities. Can be done at home. No competition, No capital needed Write to Breaghtwhite Outed, 56 Park

MANUPACTURE for us or sell direct to homes or public buildings A new inven-Marie fun disca sied in caste Relation Alleght Special's Co. Burback Ca. f.

MAKE money repairing seases Hig oppor-funition. We show he how he d stamped envelope, Ackern-an, Box lead,

ty Excellent count at y licepes as sample 10c (refundable) Bender Froducia, Mantic, N. Y.

OPERATE Steady Business resilvering mirrors, making clupped glass name-plates, signs. Write Sprinkle, Plater, 520, Ma sun 7 to

"MAILMONEY Pacts" Outstanding maliorder magazine, Copy, opportunity of-fers 10c. Vernon Publishers, West Pair-Same Pro-

START Prof. Fin thing business Develop films, make money details stamp Prof. to Promotion Service, 136-C, Grandy,

RAISE Earthwarms for profit " New interes he home business Hureau Zoo, og-frat Research 2002 H section from a Ill. OFERALL home Lipping agency for rich Lunt 36c. Adams Agency, Businesses.

64-PAGE Book of ter ed plana 25c, Oarey, Box 44, Station S, Brooklyn, N. Y.

MOTION PICTURE & BOUND FAIL CEMP AT

LOOK! Nathment advertised mosts cameras, projectors. hims, accessor, es. Pay-ments low as \$3.50 monthly Bend 16c for large two color catalog Don Eider's, E736

Will it new for free ca alog of morto equipmes and from more to We are rever or derson. Paramost 1 Mrs. Company Dept. M-16 Bits 214, Back Bay, the one biase.

S and F na Sold Eschanged Pring Ca as gue will rample art D.m. loet On dea Phin J.7 West 5002; New York

All Are of Refer of Company's new Moreon P ure Reflector aux anceed to d Cres and Or at Increase

LEAKN Mat in Picture Projections management advect a Free Calading Circles, Theatie Inscripte, 315 Washington, Fm 's W Y

OC THINSE P IN 100 ft. 16mm \$1.00 25 ft. double from 180. Processing included. Pres bargain lists. Home Mevies, Rox 2186, Easton, Pa

SAVE 60% on Movie Films Send atamp for sample and circulars. Genera Com-pany, Davenport, Iowa

ART Plims, Lists Free, Sample 100, Parkwar Kachangu. 164 Rastorn Parkway, Mit make that

FIDE Sample and lists movie fame, (rada.i) Company, Jackson, Tenn

ADULT Filmel 45 00 Lightmenerst Cata-log, Lone Cleaner, 10c 393, Elmira, N. Y. ART Plims. Sumple, dime, catalog free Cine 4214 Lincoln Chicago

ARTYILM! Sample catalogs gift offers, dime! Parislan, 4238-B Lancoln, Chicago, UNUSUAL Art Catalog, sample film dime. Erwine a Laboratories, Allentown, Penna.

MOTORCYCLES, BICYCLES & SI PPLIES

CROCKER Sense tional new Stream) ned Scotter 110 M P O. E Z fiding april 2 frame, forks, Automatic Clutch, World's greatest is west value Blamp for Cata-lor is, Dealers Wanted Clymer Motors, U.S.A. Bales Distributors, 322 West Pice, Poi Water to

MOTOR Somer engines, parts, Latera-ture, 6c. Gold; Motor Scooter Co., Name,

MOTORCYCLE, parts, accessories. Most complete stock, New & tued, We specialthe on Mail orders. What do you need' It page catalog 10c. Whitman Motorcycle & Supply Co., 466-9 Southwest Blvd., Ransas City, Mo

MOTORIZE your bicycle with blideo 4-cycle power unit. Pits any standard bicycle, Send dime for its aits ion as rec-tions and price. bides blan facturing & Distributing Company South 13th and Kentucky Ave. Historian W.

MOTORCYCLES records wheel New used fock Ba ga na 1 strated to able 15c ind an More sche Bales Kansas C v Mo Bay You Mo or Ou board it day on oan

pneumatic wheel, junior and heavy suty models Dept. 56, Richardson Mig Co., Autora Mo

NEW and used motorcycle parts and ac-cessyries. Elmer Nelson, Lastotile, Ill.

MUSIC, MUSICAL INSTRUMENTS At USIC composed to words Reaming Pamphlet on request. Promograph recording of completed song Send poem Keer an Studies, Dept. PS. Box 2166 Br dayport, Conn.

OR GANAL in asse component to your words.

15 Sing recording posts on the fact a

Not Regional Review Chatham New
Jerser 10 years of usch organist

PHONOGRAPH Records the Catalogue Paramount Mil 200 Last Market Wilson-Barre Perna

BON's Porms wanted Free examina on M Not Manter of Music 5,5-P6 South Alexandria Los Angeles, Calif

WANTED! Lyrice, melodier for songs We

Arrange, publish, suil, Superior Song Bludios, Passale, N J OR. HESTRATIONS Popular backnown ters S.S. complete S. Surrman, Music-mary 2306 Language Ch. agu

OLD GOLD, WATCHES, PRECIOUS STUNES

COLD 335 conce Blue aid gold leath growns jewelly we come receive cach by retire the L Battafac on a antered free informs on Dr. Wei berg's ford Reflering Co. 1630-B Henneym, Minnespull, M NA

ELOIN Wa'them Watchen \$) 50 Make big money, Free watch and jewelry catalog Pignosch Jawelry Eithange, 163-2 Canal St., New York

PATENT ATTORNEYS

ENVENTORS Take first also toward prothering your investigation in how obliga-tion Write for Proc. Herord of Investiga-form for each third data of recent or Wi-aless and Proc. 68 page back. Pu end this and the Investor sterning impor-tance of ground as well declared above. Pe ent table of prompt as say contines a) we have seen but to be and the let steel are detains of convenient payment plan for defect free Parent Dunle and Record of Inventor form today (arente A O Brien, Registered Patent Alter my 1A2B Adams B.dg., Washington, D. C

PATENT your Idea, Write immediately for two free books, "Patent Protection" and "When and How to Bell an Invention For a state of the second of t Or may you a super class As at the of de lang. Address School J. Eland & Co. Registe ed Patert A orthogo, dli A Vic or it de Washington, D. C.

INVESTIGITA Pa en sout inser es Bend is a fue our new 2 en cope aga ed booket. How to P dect Voir It est en and Inser on Record form This bookand ther on Record form the his sup-let guides the architecture of from the his sup-thward he ent projection to final print making from his not room Reasonable fees commended to a tourise. MrMc. would herman Regis and framis. A torners. Its P. Barrier M. dg. Washington, D. C.

INVENTORS Before disclosing your in dence of Cos on an Artedy of Cos ernmer Land Atowness Pres and mar ic-I mis Sen free Lan safer A in ne & Rom soel, 413 Bowen Building, Washington, D. C. PATENTS Scotters | per Righest refer-e rea Best trains Pomptiers assured Wa son E. C. eman Palent Langer, 126 Winth St., Washing on D. C. PATENT Par a are and blanks from Armstied. Sterling Buck, Posts P. Washington, D. C.

PRVENTORS Sand for free copy my Th-page book on painte Reasonable terms Prempt action Confidential personal corr-ice L. F. Randnipts, Dept. 346-A, West-ington, D. C.

PATENTS Personal confidential services at reasonable rue Press pary informaeur bid anneaust 2a Um firm.shed w host obigs son Julin B Thomas & Co tour By B W, Washing-ton D C Established 1887

INVENTOR & O. de free full information about patenting selling inventions Prank & Ladermann, 156 Hannau St., New Tork

PATENTS

WANTED Inventions. If you need assist-ance, financing of Want to sell your in-vention or patent quickly write lodgs to invention-Service Co., See 686, Magers-

WE decrease by sed intentions po en ed-used impatented. Write is, if you have a pen tical, useful idea for sale. Chartered 1 to s of American Intentors, Dupt. 3- B. Want magton D C

GET an CPE at occur of larget United. States Paters, in any field the last from \$1.00 M J Marsin, 100 Rest 62rd, New York City.

PATENTS FOR MALE

MANUPACTAR NO. Marketing rights
M. M. cam Posts Denna Sport M. cam
Done 4030 A Dunay Ave. Long Mench Ca. f. Ul TRA Modern drinking-four ain fac-cel-combination for every slink in every home, P. Pahlow, Hillside, III.

microsoft was to

MOSICRUCIAN Secret Teachings are ofperiod of fitting which seek to use friend solely fur the perfect on of their inner facultion and in he mastering of the day restion of Bonichiciana will be had to to receive the requirets of those who be one that wir liness and aircerity determine the right for one to have much widom to them a copy of The Becres Heritage in faictnaints book will be given without price let this book guide you to the conso varies plan whereby you may waden your scape of Person at Power Samply address your latter to ther be Q M C. Amore Tomple Bancer sering Park San Jose Calif.

BE a Personality' Speech to the American the march of the through your Effective and the march of the through your Effective accepts that of the through your Effective source in your outs burne. This short excise to become and for You Will a local forms I at It idented that a of the transition is the state that a of the transition is the state that are the transitions in the state that are the transitions in the state that the transitions is the state that the st

PUNCHARE frug au idrien in thous em-barrament at artic is whitenale prices. At meritar dies sold in the mineral back marantee, Price \$1.75 gross Dute Products (s. 266 Washington St. Bullano N. T. WIN Price Morrey Bushington Bu result) tion en mg. of we have life post and Billion in a ing \$1.00 000 00 prises the ideal Wild Palatabers 6513-L. Cuttage Grave

#ICK Incouraged' Conquer fear happine a success as and Inspering of of me ton Frut Mercentsyntreen. Moureerie

FURCHASE drug syndries at tremendous saving without embarrasament Send for

PSYCHO ANALY: 8 11:40 A meet of greaters and the first of the first of

SINL'S Trouble If a victim of Catarrhal Infection write National Laberatories, Benj. Franklin Station, Wash-ing on D C

PREE! Christmas Book Catalog! Write Old Prof a Book Shop, \$16 Arcada Ct Pondine Mich

CONTEST Bulletin. 22 Bur pages contest he on the Contest Bernice, 1909-P hast

LEARN Ventrings in De stamp brings passir data, Smith, Rosm, 196, 301 Mapellow Peoria, III.

Goodwin \$1 1038-17, Des Moines

PROTO FINISHING

SEATTIFUL Enlargement from each pto-ture on roll 25c Cut Rate Photos, Dept. 4-6 Janesville, Wie.

IMMEDIATE Service! Pictures returned same day order a received B steen guar-enteed Deck.ed Edge prima from roll 25c One colored or and plain enlaraements plus I Deckled Edge Vena prints on a Me Musea. Co pun las Salden argement plus with each the price Ally Management plus for the each the grain developed Vaporale Tree en and earl good negs to started to 3th on Deckard Edge Vests paper on't \$1 On Re-leads M suprage 50, 18 exposure, 35c 324 Deckard Edge reprints 6c each 24 hours her tee Details sugapte and the set free on request American Studios, Box 52, La-

PECHA PINISH ISMM IN exposure to hi and mer'e by entanged of hy 4' gassy prove the New rac units methods and prints the New rac using methods and eq pment make it a law pr a plantble Car der remaded with Kastran P is K. Car dge remaded with East an room guntan-leed to motivy back. He e or the main ag bear and the main Tell to the lab-ma ors 46! Milliown & North Receive of M.Y.

Title ad worth for in new users of our reg or life ser or Ar an is inductory after 13 get for like our store or full or y like This includes that developed at pe has or arged deat ed dated on Veins free paneed on argement ablushes premium or , as O r with campor be surpassed in a so r Berd this ad tour film a d like to to Mart H have that 110-32, Quincy Mart

Pickel One rull desembed and printed free dust to get and a bind we will beautifully desemb and print sour first die desember and Pree plus 5 q Tatich enis grown Pres also sense that new folding it is to its literate viat pirts a free with rits and it rice og the fur hand ig and matting appreciated). Deam Studios, Pept 1000 Omalia Netr

FOR the Discriminating Amateur-\$ expo-

PINER Prishing specials 200 for first self developed Your choice 16 pents of 8 prints and one robused enlargement Genuine Miss Tone Majorally known superior quality for abjected that Moon Photo Service, 300 Macon Made, La.

PROTOGRAPHY for pleasure and profit Propose for profitable business or faxol-maing house at home Common school education at five ent. Write for info in allient and require ents. American Behind of Photography 2001 Michigan Ave., 1991 I DC L7 Ago

Overester Prints Tour voll developed and 5 o ereste prints 35c from 216, 126, or 127 size negatives you receive 436 tuch pi nts All sma let a seu receire l'ant ; irch prints Repaints le each Overnig d service Parific Photo Bervice, Ben 644, San Francisco, Calif.

a ENLARGEMENTS and films developed, 10 stre or amaller, 25c com Special Offer enclose thus ad and negative for do not weight hand colored enlargements Proc Erusse Photos, Box of Dept Phil

ROLL developed 0 prints and two en-largements 25c. Beautiful photographic Ch trace Cards or Calendars from your negatives, 4 for Sec. 17, \$100, envelopes uded. Young Photo Service, 606-C, A bank Y

PREE Trial-16 sparkling Lifetime prints, three levely Hollywood enlargements and Pres Lea hering france w h r) 25c 20 repr n = 25c no 61 po Cherr ghi serres Lifetone Studios, L-27 Des Moines, Icha

IS LIPETIME Prints I speckling Nuclenous entergence a seat re 23c 21 re-prints 25c and \$1.20 Fin shed 3 hunra 25 other bargains, Oversight Studio, Albe y Wisconsin

PRESE 3 protections, 327 militariments of sour own of son 2 g aran end sets of price 26 or in the year only 7 m descripted all for 25c original other on a Aro Studies. Dept. H. Des Moines, Jowa

Bold developed and I beaut I I enlarge me in 2 to a firmer larger, deckied edge high gloss. Any Il exposure that the front Reprint en aryemen a 2c rach A'den Proces 258 C As or H s'ring Bin on Mass 2XTRA Special, Five-5x7 enlargements, 25c, Cardinal Photos, Summit, N. J.

CANDID special: 35 Millimeter rolls enlarged to 31-x414, \$1 00. 18 Millimeter rolls, 60c. 31-x414 reprints, 3c each, Brawn Photo Company, 1819 60 Emerson, Munaspotts Mon

SENLARGEMENTS for Twelve brant ful deckle border enlargements plus Free Lea, ertone Frame and negative holder or 'v 25c Send to is or negs ten Lifetone Studies X 27 Des Mocnes lung

CHRISTMAS Cards Bend negative dime-for samples Emargements 4x10 Jun 35mm developed. Photo-Hall, Box 12, 35mm developed. Photo-Had, Kingsbridge Sta. New York City

FINERPOTOS for 30 years Roll developed and is prints, 25c, Many other offere Satisfaction guaranteed. Finerfotos, Box R. L. I M nnespolis, Minn,

20 REPRINTS 25c 1 to 41 00 Reli de teluped 16 penta 25c 5 x 7 an atre-menta 16c 3-25c, Nordakog 54, Mayword 20.

ROLLS developed, two prints each and 'wo lee enlargement coupons, 25c erpr nts 2c each, 100 or more, 1c. Summers 84u the Uniopribe Mo-

BOLLS developed Two beautiful double Weight professional entergements Never Fade prints Mc Century F. Contary Photo Bernice LaCrease, Will

IDEAL Photos beautifully finished with wide border, deckle edged. 25c per roll of and Pres enlargement. Ideal Photos, But 2251 Pa cram N J

LOOK Get Stateen propin per roll 23c plue yas abse couper on 3-416 2 527 or 1 8110 enlargement. Modern biudios, LaCrosse Will

PREE Beaut ful a bijm with ret opbane enprints 25c Barre day cervice Prio Tof prints Pho He & 24 O9 H grand Park Mich

OUMMED perfora ed a superire photo-graphs Negat valunecessary 100-4 00 25 50c Wardwoode, SP-1 Wassinglood, graphs Negat vaunnecessat 25 50c Wardwoods, SP-1 Cur n

ROLL Developed - 18 guaranteed prints two co pure on enlargements 25c Smart Photo. Winons Minn

16 OVERSIZE Decaledged prints and two enlargements, 25c. Ow.photo P83, Wenthwrford Okla.

PORTRAIT Quality Velour Black on-largements 5x7 25c 0x10 15c Strapbook

434 ENLARGED prints from your roll 25c. Sunbeam Plim Bervice. Box C-374. LaCrouse. Was

FINEST reprints Ic up Free information Write Contacto Needbart, Mass

POULTRY & SUPPLIES

MAKE more money raising poultry, Colored pictures of poultry and most common poultry diseases a pplement is unble to it mation Six months like two years 25c American Poultry Journal, 576 South Chris. Chicago.

MAKE Money with Poultry Read America s leading poultry magazine Pive years \$, 00 one year 250 Poultry Tribune, Dept E 51 Mount Morals In.

LOW Pactory prices on Paultry Equipment Wire faction Free 100 page catalog Brasey Pen Products, \$131 West 65 h Bt 可调整的

PRINTING, MULTIGRAPHING, MIMEOGRAPHING LABELS

1000 CIRCULARS 7 to -6:25 0'19' 63 00, 83 "x11"-65.55. Ce.tel-Endrey 801 1 West 181st, New York

PRINT Anything reasonable State requirements Hamilton Press 414; N. Mende Chicago

BANNERMILL Letterbeads en elopes all words and 217D Lewis, Duluth, M. o.

WHOLESALE Prices. Everywhere printed Wisconsile 118- Z East McDaniel, Springfield Market

6, se POSTPAID 100 8' t I Bond Letter-brade and 100 errel per Bennevale 907 West Rosewelt, Philadelphia

PRINTING Bargains and samples. State business, Bicocan 2024 Obear, St. Louis

PRINTING OUTFITS & SUPPLIES

PRINT at home 10c will bring a complete catalog of presses, type and supplies. P Penfer & Company 4 Columbia St., New-ark, N. J.

INEXPENSIVE Printing cuts. Send dime for sample and catalog Neeks, 105 North Ave., Chicago.

PRINT your own cards, stationery, circuadvertising Save money S.mple rules furnished Print for others, nice profit Junior putat \$4.25 Senior outfits \$16.56 Details free, Reliey, Inc., T.4, Meriden,

INEXPENSIVE 6x9 printing press Details free. Novelty Shop, Downsville La BARGAINS Presses Tips 1 to Je Ex change, A 77, 196 Cook, Meriden, Coun

PROFITABLE OCCUPATIONS

EARN Cash daily ruising much rooms in cel-lar shed, garage. We buy al, you raise. married too, and I create guaranteed mag-1848-AG Lincoln Ave., Chicago,

RADIOS, SEPPLIES & INSTRUCTION

RADIO engineering broadcas ing asia to and policy radio se vicing that ne and Morse telegraphy taught thoroughly All expenses low. Catalog free. Dodge a Institute, Poplar St , Valparaise, Ind

MADIOS 47 05 up kits 63 95 in Point plets Ready to wire 5 10 tubes. Save 54° Ca Alog. Free, User agents wanted, Marco-ke Karlana City Mo.

RARE COINS

BUY by Mail U S. and Futzign co.rs Collectors' accessories. Hinstrated Cats logue 10s. 2000 Quotations, Dime refunded first order James E. Randall, 37 West Van Buzen Chicago

PREE! Pureign coin, banknote and in au M page humiles ed cum calengue to ap-proval service approan a Bend la postage. Ta Lam Cumco Springfield Did Mass

Will pay \$10.00 es h for certa n Larrotn Pinnies Indiantendo \$150.00 d.mes \$100.00 Catangue los Federal Coin Ex-

COMMEMORATIVE 61, Common fine 110 common flore and \$1.00 carb Retail catalogue 10c Norman fibrits, that Lage Utah

WE p rehase a little anhead pennies Pur-lasts catalogues for Wateman, 1998 Broadway New York UNCIRCLIATED 1940 S Cent and retained in Landson 6410-B Landsonhim Reth Hollewood Calif

SENHATIONAL Prices pa de Caraing se ioc CALIPORNIA Quartersize gold 25c Bish-off, 500 East 101, Kansas City, Mo

REFRIGERATION

EPRICERATION Repairing that or-REPRIGERATION 1200E Delancey, Philadelphia,

RUBBER STAMPS

CUARTONED 1 lines 250 1 350 Ours are better Ad Crafts LaCrosse, W.s. I I NE Cushimed 25c 2 for the Print-

SUNGMILITERS

WANTED Porms, to be set to music B ben ! for consideration. Transcr palica records made. Ken an a Bludio, PB, Ben 2144 Heidgeport Curn. Porms, to be set to music for consideration. Transcrip-

SONGS and Song Poems wanted, No I House od Recursing Stadios, Sild Preum Sta Lie Argeier

SONOWR'TERS wanted Rad o informa-

bureau & Phi Thomaston Manie bureau & Phi Thomaston Manie bowns Song Poems bought published Best offer Pice advice Me to Mesody Monte Polymbian Bass Francisco BOND Poems wanted Bend poem for ap-pro-al, free booklet Pive Star Music Masters, St Beacon Bow on

BONGS puerso, our sidered for p. b' at son

I may bear Dept 8 Radio Muste Co., SONG Poems wanted. Pres examination McNeil Master of Music, 510-P8 South Alexandria, Los Angeles, Calif

SONOWRITERS, Write for free booklet profit sharing plan. A lied Music Com-

WANTED' Original song poems Richard. Hrs., 146 Woods Bidg., Chicago.

SPORTING GOODS, GUNS, FISHING TACKLE. ARCHERY

LIKE Ouns' Enjoy Shooting' Send Sc stamps sample copy 64 page monthly ages e etc. assets about guns. The magne e etc. asively about suns. The Washington, D C

ARCHERY! Complete archery instruction. book 70 pages—200 illustrations—30c. Catalogue Free Trungle Archery Com-pany Barrison-State Streets, Chicago HCNTING trapping camping equipment.
Used guns, Catalog, Howe, Coopers Mais, Maine

STAMP COLLECTING

NOTICE

Readers are invited to take full advantage of the stamp offerings available through ads asking for Approval Applicants, Such applicants receive a selection of stamps on approval which may be purchased at prices indicated. Payment and return of underired stamps should be made within ten days after receipt unlest otherwise specified by ndvettiger. Applicants who fail to follow these instructions become subject to Section 2350, Postal Laws. and Regulations, 1932, which provides extreme penalty for obtaining property by false pretense.

Clan't packet 200 at different from Africa. Bouth America. And Both Sea Islands, etc. Includes World's simulant stand transfer and distinct shaped placing an right stamps Micaragua Will Rogers a rings, many others And packet 17 different United States (catalog up 1500) als planets for stands of details. and on commen oratives etc Tota cal-Everything for icental ut to be to approva, applicantal 6 amp Company Dept. 34 M. Camden, New York

SUPER-WONDER offer comprising stamps from Aighanistan, (oblony), Transjor-dania (entry North Bot to theffalut, March has many rums Sudan (see 17), Comeroon (beauty) traq (inte king), Brunel (boating), this entire lot absolutepr free for 3c postage to approval applicants. By Illustrated lasts free Kenk Stamp Co., G. P. O. Box 67 (24), Brooklyn,

POSITIVELY Greatest Free offer-Latent Seof a la erica conni fil 10 Album cover ing on the wind our arting hissofated descrip to spaces tot James amps that is a set of the Range cloped on the Philadelphia and Philadelphia and a style Pres when you become require Present Approva Customer Bares to Stamp Beryson. Burn Berrard of Carlot to

BATT ad us we seer had Pifteen years adfor to true Sent se h rest y to hh tota of-fer to true Sent seas Ne d Caymana Man-hab o Brases T the Caron B sek Solomons (Cannibaland), Everything 34 with approvals, Viking, 130-P Clinton St., Brooksyn, N Y.

COLLECTORS - Superb United Bigies staines including airmais, commemo-tion probate on approval Freshly and correctly has bered booklets. Harrjuli s imi British a d Blatep Co | 100 Keirap Br Allaton,

BFI ARGOR Prink Alban a Hatti Bb pal, Pales tie Juliore Mar ? it 20 Congo, Radan Contra R okaburra berd ai d 200 d he ent stamps or a like with app ovals. He is 8 amp Co. 4647 Kenmore. Chicago, Dep N

BESTER Different triangles only So to proval applicants Tatham Stamp Co., Springfield 30 Mass

SCARCE Diamond airmail! Wonderful pucket 115 deferent from strange countries. British Colonies Haiti Tasmania, p. torials, etc. 5c to approval applicants. Reliable Co. Dept. 3. Bus. 132 Church Annex New York

ABYSSINIA, Burbados, Haiti, Cypras, Borna Finland Grece Jamaica Lox-embra Mara Maria Nacat, Netherlands Netherland

1941 STAMP Annual Free Lists P 18th North America, United Blaces, Pere 8n Press Gray Stamp, Dept., PR, Toronto, Canada

SPECIAL-Airmalis-23 different, Includ- | ing triangles Zeppelin Lat o America, etc. be to app can a for best value a fear-lively priced approvan Continental Stamp Co Dept C Standy Hook Co. n.

PREE- 100 all different, stamp wallet, perforation gauge 3c to approval ap-plicants Gordon Stamp Company, \$75 Markenough Ave. Detroit Mich.

COSTA RICA Atrmetic 1930-33. Se to 40c-worth 50c or y 5c approvals 3 amp-tongs Free to contomers Treasure Chest, tongs Free to customers T

CHRISTMAS suger ton 50 Commemoratitue Cark is for ect cut \$2 to Fred-erick O'tings, Bouth Rolling Road, Catonse Md

FINE Approvals freship filled books and sheets Te , me what you want and I will send them Mi on Shinner 108 East Fourth, Long Beach, Calif.

UNITED STATES approvals selected copies at reasonable prices Write today Senapole Stamp Studio, Box 416, Miami Beach, P In

bo U & such drug commemoral ves, air Brup \$13 H Hai do de By Louis Mo. 500 DIFFERENT 30c 800 50c 1000 \$1 00, 300 DIFFERENT 30c 800 50c 1000 81 00, 2 000 83 06. Fred Onken, 630 19th 81,

NINETAEN different Newfoundhald on coading Coronation, 10c Arlane, 2008 Data Bronz N Y

PREE 13 Different from Roumania or Cascho or Pound to approve app cents only Reimers, Plating, Fort Worth, Texas, 60 DIFFERENT China Pres to approve appurants encione g postage. Poggenburg, Out Lang Photadelphia

HIGH Grade sets. Approvals sent on letter Bistop Co. Retricta As Long City & J. 1000 MIXED foreign 25c Web worth northing for values. Plans Stamp Co., Santa Fe. N. Mex

1000 DIPPERENT stamps from world \$1.00 Catalogue value about \$25.00 500-50c Denters Dept 8 Box .013 M waukee W s

applicants, Charles Kuehne, Statersville,

U. S. Commemoratives-26 different-10c Approvals Quality Stamps, Engisteed,

55 SELANGOR, Bolivia, Ecuador Pales-tine, Egypt etc. Approvale So Libby Stampeo, Station P. Box 43-E, Brooklyn.

UNITED States \$4 and \$5 stamps Free to suproval applicants set dina 5c for 100 all different. Wirel 1. Woodbine, Penna 50 DIFFERENT United States Many com-memoralives, Sc. Gerhardt, San Saba,

16 CANADIAN commemoratores per estala 20c; 23, 35c Dufort s. 4403 Chalmu-briand, Montreal, Canada

U S and Foreign a anga on approval 3c postage, Americ Approval Co., 318 North St., Middletown, N Y UNITED Blates stamps on approva. Is w-America. Stamp

est seiling prices in Ame Company, Albany, New York so FREE Catalogued \$1, Album 3c, Bul-lard, Box 13, Winter Rill, Mass. CONSCIENTIOUS Collectors, your want lists for beautiful U.S. stamps welcomed. Law 8 Endicots Ave. Marblehead Mass. PREE! 50 Different Belgium, le postage Apprevais. Officie. Bramps, Pair Lawn,

PREE! Pony Express set (facsimilies). Postage 3c. Roberts, 601 Sheaverbudg. Bayerr Mich

SCARCE English Pre-clamp cover 5c Penny app ovals Omer 551 Highland-way Haper own Md

Ma,ta, (Intree Passing. Helangor wite

Ma.ta. Hother Paleting. Lothery Middletown Conn \$2.00. \$5.00 2.000 U.S. Pree Box 568d, Manchester, N. H.

APRICALLE Beven different U S Armani 10c. Rises, Bowling Oreen, Onto

PRES! Amtria War set Postage Jc Wil-liams, 50; Archerbidg Bayesiy Mich PREE Canad an Reval Visit Dobres, 4100

Gerrison Blid Bar imore. Md DANDY Approvals, Worldwide packet free. Munjer 1542 Waverey, Conclune i, Obio PENNY APPROVALS (50000) Gulf Stamp

Company .78 Brookside Irvington. N J 100 U S revenues on documents—10c (700—50c) Vanyoochets, Hyndman, Penu SOUTH American 100 different 100-with

approvals Davis, Bilter Lake Ind PENNY Approvals that satisfy Neil Grou-berg, Box 54418 Phi ade phia Penn

PREE Pictorial Packer with Approvals Wischarl, Dept 11. Prankfort, Otto

PLEASING Perny Approvals Janice Swen-

SURVEYING INSTRUMENTS

QUARANTEED Factory rebuil frank to and levels for rent twith purchase oppar trade in, or buy your old instruments. Ship prepaid for each value ion. Wit a for its PM61 and complete information to Warren Knight Co., 136 North 13th Ct., Pos adriphia Pa.

TATTOOING BUPPLIES

TATTOOING Ourfile Supplies I lustrated Lint Free, Percy Waters Annieton, Aig.

TAXIDERMY

Ol.ARS Even, Taxidermats' Furriers' sup-pies Big estalog Free Elwood Company 238 Smith Bidg, Omaha Nebe

TRAP Fox or County Bare ground and deep anow Irapping Results or no pay deep anow Irapping Results or Q. Bunch, Box T. Weich, Minn

TREASURE FINDERS

MT SCOPE Metal Locator fully guaranteed and unsurpressed in emclency Time pay ment pan, Itale in and accessories Free literature. Fisher Research Laboratory Stern Lure. Palo Aito, Calif.

Typywriters, office drywer

TYPEWRITERS adder mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at haif price. Prosts, 22 Prosts Bidg, Chicago. WANTED-MISCELLANGOUS

CASH for used microscopes, benoculars, a ide rules, drawing sets, scientific histraments, tools, cameras trans, a flausfaction guaranteed Elman a, 106-8A South Clark Chicago

WANTED False tee'h, crowns, bridges, gold platthum lewelry Goods returned it price a amatisfactory Western Metal Co Biomington II

MERCURY Cash pa d 8h.p express De-ts a sent. Wholesale Perminal, Nortt a sent

RAIK YEAR

WATCH REPAIRING is steady profitable work Experts mus of in demand You can learn we chuncing trade at home, spare time. New original instruction asstem. Script engraving course included Write for free details today. Nelson Company, 500 Bharman Dept. A 2010, Chicago

WATCHMAKERS Materials tools watches leneity Bought sold exchanged Best prices for oid gold diamonds Ben Begal Company Mailers Bidg Chicago

WATCHMAKERS Tools supplies Watch parts Lowest prices Write for price ast 45 Dwan Company, 87 Nassau & New York

WELDING, SOLDERING

EVERY Welder should own Audels new Welders Ou de Price 1. Highly en-dorsed Easy to read 400 illustra ed pages Important theta Handy informs ion all branches covered Anamers quest one Only \$1 pumperd Money back if not O.K. Audel, Publishers 69 West 23 St. New York

D C Arc-welder Build it yourself from Automobile generators, Vehicle motors, Light plant generators, Plans \$1.00 each. Welders Club, WB-J432 M-Mart, Chicago For Saw 100 amorted vehicle meters, low 64 \$20 00 mach

BARCAINS, Demonstrator are welders, gasoline and electric drive Build your own portable, save \$500 I berat Trus! Easy terms. Write Bobart Weider Eschange, Box P-111, Troy, Ohto

BCILD 60-200 Amp. A-C welder for \$10. Severa plans \$1.00 Information dime. Ht Point Electic Products, Dept. P. Bestefontaine, Ohio

SAVE Money on guaranteed rebuilt Arc Welders All types and sizes idlers-governors and supplies Electric Welder Repair Co 3624 Euclid Ave., Cleveland, Ohio

ACRTYLENE Weiding generators lates type \$25.50 Johnson Generator Co Later1 Brook Beld Mo-

AIRCRAFT Welding Out file \$23,17 to 418 03 Superior Ony-Acetylene, Hamilton, Ohio

BPOT Welders \$60, Bixteen gauge Gale Hollinger Olen Ellyn, Ill. 110 220 VOI T are weiders helmets plans,

material Holgerson Canton, Kanasa

LOWEST prices humber veneers, panels Free price list. Woodworkers Supplies, Box 131, Negnah, Wis



The HOME

A new book which shows how to set up and operate an inexpensive home laboratory with

odds and ends of material available in every home, Many thrilling, practical, useful experiments and tests, entertaining, instructive, valuable, pointing the way to research and new discoveries. Many diagrams and illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY, Bupt. 11 353 Fourth Ave. New York, N. Y.

SUBSCRIPTION COUPON

Доличительного материаличическия солическия систем и полическия и по

POPULAR SCIENCE MONTHLY 353 Fourth Avenue, New York, N. Y.

Please enter my subscription for Popular Science Monthly. I enclose

\$1.50 for one Your

\$2.30 for two Years

1 t

NAME.

ADDRESS

CITY_

na de les de la celebration de la company de

STATE.



You Can Train at Home in Your Spare Time

The W. B. A. practical space-lime method has trained men and women of all ages since 1914 COMMERCIAL ART. CARTODNING, ILLUSTRATING at the one compacte course. Learn to draw kep by step Trained Art has are capable of exceing \$40, \$70, \$75 a week Write for FRIE BOUK, "Art for Fleature and Profit—" describes course. TWO ART OUTFITS included with training—State age.

WASHINGTON SCHOOL of ART, Studio 131T 1115—15th St., N. W. WASHINGTON, D. C. details

Become a filling technician in one year ready to take advantage of increasing apportunities in the electrical field. Bine men, today, fill key positions in many different electrical industrias. All received the same course in

fundamental theory and practice.

Modern isborateries. Successful placement, 48th year.

Ask for free vecational phart, 10: Takoma Ave., Wash., D.C.

ELECTRICAL SCHOOL





FERS YOU GREAT FUTURE

Demand for trained stressfromes is increasing and already in trests supply. Curious Wrighte Tech, Accessor's Intermosa school to located the Grand Canaral Att Terminal on bears of the neverals following and specialists in training MASTER AFCHANICS and AERONALTICAL ENGINEERS (No firing involved) Gradusen pre obtaining immediate employment. drinks NOW Dept. Pd-1

Curtise Wright Tochnical Institute, Slandale (Los Angeles) California

EARN A AT HOME

From A Chartered Institution of Higher Learning Employers New Domand College Graduates With Degreet

OR Degree Contract to Arts Sciences Philosoppy Advention Public Health? Mentral Jurisprudence Psychology, the lossey Physics Chemistry Condens Policions Theology Law Business Training Accounting Statestic Agreey inset Resistates. But the theology of the International Authorities, Stema Chemistry, Advanced Resistant Constant Property Accounts Associated Resistant Constant Resistant Re McHisley-Restovelt Graduate Cullege, 4810-A Shorden Road, Chicago



Paye He Own Way. Print Your Own

stationery muste titles greeting cards church work, etc. Fried for Citizen Manay is in Junes prima St. Senter 31 Sold dire on y Return primary is regraving to Fact rates With the catalog & of details. Return, Inc. M. 23, Meriden, Conn.

Send for FREE 48 page illustrated book on spec-

Scale Model Trains and Equipment. American Flyer Trains, 425 Erector Square. New Haven, Conn.



MCCARWIE SCHOOL OF MECHANICAL DENTISTRY 207 H Brook \$4 Deel 682 Philodelphia, Fo.

0.0



for callections Pe ce Lat the his Institution the prices I just for 750 different dis Some his to 17 each Send 17th not stamps). Housing ed Prospectus before sending butternies are rodus (Est 1912 Mg Sinclaim, District WHITE LOCAL CENT INTO MER SINCLAIR DEALER IN INSECTS, Dopt. 7. Box 1830. San Diego, Colf.

STALOG

this amazing service. Used correspondence courses and uducational books on power subject 100% seasofaction guaranteed. We buy for this we after unbelievable bargains. Send your name on penny pertend at each life obligation.

NELSON COMPANY



il se, don't let today's great Aviation opportunities get away from you. Just consider the record of Aero ITitrained men . . . over 700 have entered Aviation in the last year alone . . . over 250 have been placed with a single famous aircraft plant. For these men Aero ITI training opened the door to careers in aircraft production, aircraft maintenance, and aeronautical engineering. Choice of three courses in Aircraft Mechanics, two in Aeronautical Engineering. You can take full time training at the school or start your course at home. Find out about Aviation careers and Aero ITI training ... send for details NOW.

Aere ladustries Technical Institute

5247 W. San Fernando Read, Les Angeles, Calif. 5 Courses in Aircraft Mechanics and Aeronoutica Englseering-Including 12 Months Aircraft Mechanics Course Approved by U. S. Civil Aerenoutics Board.

C A VAN D SEM	OHN K MONTHBOP	RON NT L G	RASS PP
Sen Fornando information on am interested in croft Machanics	RIES TECHNICAL INI Rd., tos Angeles, Aere III fraining for the following branch Aeronoulocal Engin School:	CallyPlease Aviation corner of Aviation (_, sering, (_) Undi	send s. I Air- ocid
Nome		Age	_
Address			
City	Stote	A	37.5
M	CHAN	100	_

KNOW You Need this YOUR Book CAR JUST OUTI NEW PLUID DRIVE FULLY EXPLAINED

Every operator and mechanic needs ACDELS NEW AUTO GUIDE. This book saves time, money and worry Highly endorsed. It presents the whole subject of auto mechanism; I Basic principles, I destruction, 3—Operation, 4—Service, 5—Repair Family understood, (1) or 1500 pages—, 540 illustrations showing inside views of modern cars, trucks and buses with instructions for all service jobs, Diesel Engines fully treated, 5—Tally illustrated. To bet Tale Assistance for Yearself Biology Fill to and Maid Gampon Teday.

COMPLETE — PAY ONLY \$1. A MONTH —
THEO, AUDIL & CO., 40 WEST 23rd STREET, NEW YORK Places and president 11 DELS NEW AUTOM RILE 10 DE \$40 for free unimportion If I decide to heap it first send you if within I days; they result! I mentify until mentions are principled to be paid. Otherwise, I will return it to you presidely. W C DEPEN LEW AUTO OUTDE LIDE DOOK PRYON SIDDE, DICKET

	
Address	
Ourselfm.	
Estrene	d. M.

Please mention Portlan Science when writing to advertuers.



Make hig money out of clubs, country estates, hotels, homes every place which uses furniture, with our new electric DETERGER, which washes uphotstered furniture like new right in your customer's home, using a new soapless soap which it whips into DRY suds. We have helped hundreds of men get into husiness for themselves with our automatic equipment used by several great railroads and many of the world's largest hotels.

NO SHOP—NO STORE—NO RENT

You gave this expense for you do the work right in your customer's home. Barrett says, "Took in \$28 in a ght hours," J. M. Corbit took in \$279.50 his first month, J. N. Ankrom wrote, "On my first day I got two jobs—one for \$11.50 and the other for \$32.50, his customers are delighted." We went more embilious men. If you

are that kind of a man we can bely you start in this hew business where you have wonderful opportunities. Only a limited amount of money is needed for the first The basence you send on easy terms. payment. The baseon you send on easy terms. Deterger is ready to run when you receive it, and you should be able to make money the first day.

BOOK, "Your Own Business" Sent FREE! Write today for this hund-points out a brand new apportunity and tells you how daily it is to get started in a blastocka where you are your own toke and can stop werrying about fuct a job, Write today—HOW,

von Schrader MFG. CO.

\$11 Pt. Rucine, Wisconsin

PARM BY DOING"

I'LL FINANCE YOUR TRAINING!



their ready new for a good job in giope tricity. My Rig Fran Route Lelia put how we train you in 12 weachs, by actual shopework on real electrical machinery. But by hacks or correspondence. Assuming plan apalish you to get training form their their lake 12 Months to pay in small monthly payments a sarling 10 days after graduation. Experience or advanced advantion not reached Many Earn White Learning. Freq fetters employment exprise Diesel Engines, Radio, Evertic Refringration on Jair London oning manipoles in Mil. COUPON for FREE BOOK and All Louis and All Coupons.

H. C. LEWIS, Pres., COVNE ELECTRICAL SCHOOL.
BGG C. Paufins St., Dept 11 73 Chicago, III.
Nend free bink with Facts on Cayno, the Pay After Greation plan, and units 4 weeks Radio Course new include

ADDRESS.

CITY

DIMECT F 401 60 T CH ш 4.5 Z |--12.1 64 to 55 to 114 Santa. YFAR GUARANTEE GEARBORN MICH. DOLDENTONE HAD B CO

Learn to MOUNT

Taxidermint, We teach you ut Home. Mount Birds, Asimels, Pets, Save pour built-a buse and des.

common specimens flave poor built-ing trophies describ bune and dea. Make gentine HOOME LEATMER, tan end quite up fure for specime profit. FREE BOOK of pages— cathe gil about it.

Busters, get this wopderful book its Naw Free. Send postal card Today—
This Minute! State poor AGE.

W. School of Takingrany, Dopt. 2231, Omahe, Nahr,



A Revelation-Our new 1941 Catalog of "HARD-TO-GET MATERIALS"

For industrial Arts Departments in Schools. Institutions etc., Purniture Repair Men Calunci Makers Souvenir and Antique Shops, Romerzsters etc Send IOc cash or stamps for this new catalog A few at the Ireas we sell;
These hardware locks hinges supports tray lifts copper trim, slap mon dings overlays etc Finishing mater als give stain variation attractive papers and indirect flatures that reach splice recent cardial creation of the Ireas and indirect flatures. Chair care splice recent cardiator of the Trays and glass increase for annihing stands large line electric and spring clock toovements with and without dials. Complete ine Vener an Milad hardware road tapes etc Tarins a kies and supports. The wagon whereis and casters. Would down a slar downlar complete with fungels and resters would exceed the business large I no goed table teg supports. Bed hardware of every description Desk pens complete with fungels and fasts high without have Water transfers in large small mouldings etc. Chief and casters office class a derig wood legs and K. D. chair frames Small how hardware of every description Large selection pulls hin ha, handles hinges looks catches etc. Perforsted sicel panels chair planes reporting chair far turns a road each of the class is to the first and each chair cannot handware metal drawer glades branes and rhade drawer follower blocks etc. Many styles corner branes builts etc. Step adder uppers, planets excipe a ding teach and shower Typewer ter deal hardware binaste steps of ding teach and shower Typewer ter deal hardware binaste two movements etc. Bar plane for howelles deal hardware steps and caste a series hardware awivel inp table flatures aretonal bookease berdware clamp nails, succide pens for burning ste

Thurston Supply Company, Dept. P. S., Aneka, Mian.

STUDY AT HOME

Logally trained men-win highor postuons and bigger sucrome in business and public to, Greater opportunities now than a r bafare like corporations are brained by most with legal training. More Ability: Mere Prestigs: Mere Money

We guide to a up by else You can Irsin at home during a spare I is Degree of Li. D. Surcess'ul graduates in every section of the U.S. We furnish all test metavial including 14 volume Law Library Low ruet, our ferme. Out pur valuable 45 mags. Law Training for Landstable's and Parthunger beats Philip Rend for them hith Laborates University, Copt. 185-L. Chicago A Carrespondance Institution

Regain Perfect Speech, if you

Every stammerer should have the new 187 page book "Stammering, Its Lauss and Correction . Bent free to stammerers. It describes the lingue l'nit Method for the ersentific en rection of etammering and stattering Method agreessfully used at Bogue Institute for 40 years, since 1901 Endorsed by physicians. Write for full information. No of igst on.

Besiamic M. Begue, Dapt. 871 Circle Years, Indianapolis, Indiana,

BUILD ARCEWELDER FROM OLD GENERATOR

For Light or Neavy Work. 75-200 amperes Complete PLANS and valuable cats og wildce 35¢ Over 900 Electrical Supply Bargains.

Lajay Mfg. Co., 1323 Lajay Building, Minnespolis, Minnesota



OF BARGAINS IN MILITARY, Outdoor and Sport Goods, Clothes, Shoes, Books, Blankein, Trais. Fireskein, Boy Scout. Supplies, etc. Send 10c for copy to be re-

deemed on first order.

A AND N SUPPLY CO. 4784 Leeter St. WICHMOND, VIRGINIA

Splendid opportunities. Prepare in apare time. Easy plan. No previous experience needed, common school education sufficient. Send for free booket. Opportunities in Photography" particulars and requirements.

tography" part rulers and requirements, American School of Photography 3603 Michigan Ave., Dept. 1361, Chicago, III,

/ANTED-N

to cast Christmas Goods 8 and 100 Novellies, TOY AUGUS Ashtrays, etc. Can be done in any spars room, bearment or garage and no experience necessary A rare opportunity to devote spare or full time to profitable work, Write Dept. E.

Metal Goot Products Co., 1696 Booton Road, New York City



Please meation Popular Science when willing to advertisers.



STUDY ENGINEERING HOME

From A Chartered Institution of Higher Learning Employers Demand Degree Mon For New Positions 53 Oegree Courses in Sections Reduced Degree Mon For New Positions Research Course in Sections Reduced Degree Desired Administration Actions in Sections Industrial High-one Patroleum, Marine Refrigeration Air Conditioning, Charter Degree Engineering Arts Science Philosophy Education Payentless Health Medical Desired Control Psychology Recinings, Physics Chambers Courses Payentless Recinings, Physics Chambers Courses Payentless Recining Accounting Statistics Fugasted 1901 Chartered, McKintey-Rossevell Graduate College, 4610-8 Sheridan Read, Chicago



I-STATE COLLEGE

B. S. Degree in 21/4 Years

World famous for technical 2% year courses in Call E retries Mechanical Chemical Radio, Account was Engineering, Rus ness Alm the leaf to and be sinting Borrial preparatory who lack required buch school work Short

denortment for those who lack required block school work. Short ill own courses 36 Arcket in Survey og Droft og Lew to tien Lew II og come Students from every state and many foreign countries. 57th year, En er January Merch, J. no. September il rafe for cattofog Sucton Handy Peas., 511 Callege Ava., ANGOLA, INDIANA.

ARTISTS MAKE MONEY

Fird out your ability. Send name, age, occupation and address for Free Vocational Art Test.

Federal Schools, Inc., 114) Transaction of Management (MACL)

RADIO and ELECTRICAL ENGINEERING

\$25

FREE LINCOLNENGINGERING Set good gross of wide electrical full. Modern Very updates delet from the mode and the public address shows a critical root, Trains put to be suppressed man real rections to be technician Tattion (INLY \$25, without course [inferred parameter plan Experiment life furnished, FREE Write for free copies of school rainings student magazines etc.

BRUSH PLATING OUTFITS

for autoparts, tellectors, faucets, bicycles.
No fanta necessary. Free particulars,

GUNMETAL CO., AVE. F. DECATUR, ILLINOIS

RADIO ENGINEERING, broadmating, aviution and police radio, cervicing,
marine and Morse telegraphy taught
thoroughly 46 weeks engineer-

ing course equivalent to three years' college radio work School established 1874. All expenses low Catalog free Dodge's Institute, Nye St., Valparaiso, Ind.

AVATION

ARMINDED YOUNG MEN INTERESTED IN TECHNICAL TRAINING POR ENTERING THE WELL PAID PIELD OF AVIATION AS APPREN-TICES—Write immediately enclosing stamp MECHANIX UNIVERSAL AVIATION SERVICE CO.

Wayne County Airport Sex 857 Dept. H. Detroit, Michiga



FREE

Mail Coupon Inday—

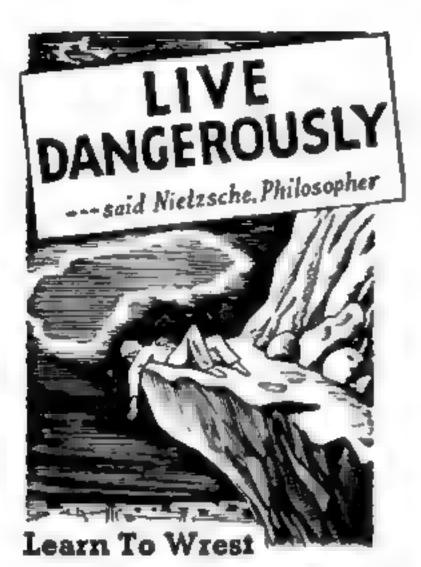
SHUE

Service Book

scription of U. S. Govern-

ment jobs; (2) A list of

U. S. Government Jobs; (3) Tell me how to qualify for a job.



DON'T HOLD BACK—life is yours to live and enjoy each conscious moment. Not in a sheltered, routine living, but only in a tempest of life's forces—which challenges every element of your nature—will you receive that inspiration, those ideas, which will bring you personal supremacy and happiness. Live boldly but knowingly—learn to utilist nature's laws to the fullest extent.

The Utmost From Life!

A FREE Book of Facts

Let the Rosicrucians (not a religious organiaution) show you how to direct little-known laws of life and mind—used by the sages for centuries. Write for the free book, "The Secret Heritage" today. Address Scribe: Q M.B.

The ROSICRUCIANS (AMORC)

San Jose, Caltiornia, U.S. A.



Please mention Popular Science when writing to advertisers.

NEW YORK

Entellibed 1902

ELECTRICAL

SCHOOL

FOR MEN 16 to 60

The naigns school—known the world over for its distinctive method of combining "Why & How" —theory with all electrical-trades practices.

From description bookles

NEW YORK ELECTRICAL SCHOOL

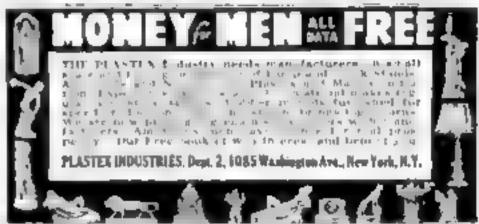
40 West 17th St.

New York City

RADIO-TELEVISION

Oldest, largest Radio-Television school in West trains you for good pay job. Complete instruction including Radio Construction and Service, Broadcast Operating, Sound, Talking Pictures. Television, Public Address, etc. Flexible plan to meet specific needs of those with or without jobs. Transportation allowed to L. A. Earn room and board while learning. Request Free Catalog.

NATIONAL SCHOOLS Dept. PSR-1



MONEY

CARTOONS!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CAR-TOOMS, at home, you may BELL! Cost is unusually four. Write for FREE details, ministers losses plains, and addresses of successfully trained students. As obligation.

RAYE BURNS SCHOOL, Studie S. Bex 3583, CLEVELAND, DNIO



Attractive FREE Catalog

Artistic pine, rings and embleme for classes and chile. Attractive prorps, Finest quality, gold plated, never, etc. Over 300 designs.

91NS

MO

IONEY IN RABBITS-CAVIES

WE BUY and get you in tauch with other parthels, Catalog and copy of magazine for send Sie for Book Catalog and Price List and Your a Subscription to the AMERICAN SMALL STOCK PARMER, OUTSOOR ENTERPRISE CO., 87522, Food Store, S. T.

Scratching Relieve

For quick relief from itching of ecsems, pimples, athlete's foot, scales, scales, rashes and other externally caused skin troubles, the world-famous, cooling, antiseptic, liquid D. D. D. Prescription. Greateless, stainless. Soothes irritation and quickly stops the most interne itching. 35c trial bottle proves it, or money back. Ask your druggest today for D. D. D. PRESCRIPTION.



I pood a twinble man in your town to wear a fine tinds-to-measure, all wool DEMONSTRATING SUIT—adventise my famous Union cothing—and take orders You can inske up to \$12.00 in a day My line southing ever 160 quality wise's un, all sensations a values guaranteed, CASH IN ON PARTIAL PAYMENT PLAN

STONEFIELD, 1300 W. Harrison, Dept. # 820, Chicago

Offers YOU COLLEGE and PROFESSIONAL TRAINING Majoring in AVIATION

Accredited by the III nots Superintendent of Public Instruction. U. S. approved as a Commercial Ground and Fig. og Mehool and Mechanical School. Accredited by and cooperating with the United States Arms Ale Corps in giving flight and mechanical training. Open to high school

FOLR courses had to B E. degrace in Professional Piloting, Aviation Operations, Maintenance Engineering, Acrosautical Engineering.

ElfellTEEN TRAINING PLANES are used in professional flight training which preferres graduates for airline flight operations 76 000 training which prepares graduates for airline flight operations. "6 000 hours flight training given. 2000 hours being flown monthly. FACULTY of 52 specia late an entirote fleids of aviation.

1580 graduates. Encodement (tended to a total of 300 commercial avia-

100 acre a sport 28 buildings detected to school purposes exclusively. Dorottories and dining hall at the College.

Winter term January 6, Send postcard for new \$4-page catalog.

Registrar, Dept. P5-1 14th YEAR PARKS AIR COLLEGE, East St. Louis, M.

Home Many Finish in 2 Years



Go or rapidly as your time and abili-tion permit. Course equivalent to resthen achool work - prepares you for entrance to college Standard H Steats supplied - Diploma t redit for it subjects already computed Single subjects if desired High school adscribes to very important for advancement in huntrement in huntre

OFFICE THE AND MONEY BAYED Degree 2 for dip one 1 processed the AND MONEY BAYED Degree 2 for dip one 1 processed the AND MONEY BAYED Degree 2 for dip one 1 processed the analysis for ming Air Condition on References of Line Arts and the straight Force from Intensive courses I made months in the straight Force from India Arts and I will be a straight on the straight of the India and I will be an include the straight of the India and I will be an include the straight of the India and I will be a straight of the India and I

DEGREE IN .. TWO YEARS

B S Degree courses in engineering Electrical, Civil, Chem., Machanical memor or Aeronaut ta, I yr Mech Drafting Approved by Civil Aeronautics Authority, participation in Pilot Training Program Large industrial center Prep courses without extra charge, Earn board if desired Low tutton Enter March, June, September, December Low tu tion Write for Ci for Catalog

\$11 E. Washington Bird., Fort Wayne, Ind.

INDIANA TECHNICAL COLLEGE



T PASSENGER TRAFFIC INSPECTOR

Our home study training prepared you quickly for interesting services job in transportations. We place graduates or refund into on. Many for interesting servacing lab in trail we place graduates or refund into grood upportunities. Graduates were per mo. to start. Established 1918. up to \$135

C Blandard Queleous Fraining facilitate



Get into the BAKING BUSINESS

Bakers make good money) New 7th Industry in wages! Nearly depression - proof New home study Baking Course qualifies you. Common school education sufficient. If you're ambittons, write for FREE BUOK. Opportunities in Baking 'Rational Saking Matthews, 3401 Sichigan, Dept 1361, Course



FREE TRIAL LESSON humor-AT HOME-BY MAIL. Ha e Make E3 money! No experience needed to start. Write to a. for FREE LESSON, maned postpaid. No obligation. MooN Gag-Cartoon Scioo, Dr. B Fait cra W s





MONEY MARING PROOF TO lawn, temetery policy made without molds or cores. New Paten ed method. Use only sand, cement, chesp materials. Thes, walls gravestones. Statuary giftware. Basement waterproofing Book et. deta is it stamp.

NATIONAL POSTERIES COMPANY Minnespelle, Mint. 13 W. 26th St.

Please mention Popular Science Monthly when writing to advertisers.



in 90 Days at Home

itundreds of men and women of all saids 18 56 make \$10.60 to \$10.00 to a single day plant beautiful Swedish Massage and Hydro Therapy treatments. There is a big demand from Hose tult, Sanitariums, Clube, Dortors and private patients as well as appear un t re for establishing your own office

Learn this interesting money making profession in your own home

by mail through our home study route. Same instructors as in our NATIONALLY KNOWN resident school. A diploma is awarded upon rempleted in 3 to 4 months. High School training is not necessary Many each beginning white learning.

Anatomy Charts & Booklet FREE

Borell new and we will include uniform sout, medical dictroury patented reducing rollst and Hairo Therapy supplies without entra cost. The teducing course alone may be worth many times the modest tuition for

Bond soupen new for Anatomy Charts and backlet centaining abetographs and letters from excessful graduates. These will all be sent enstand-FREE.

THE Cellege of Swedish Massage Dupt. 124, 36 E. Adoms St., Chicage.

unatamu

how may send me FREE and postpaid, Anatomy Charts booklet containing photographs and letters from graduates, and complete details

h.i					
Name			-	************	
Address				9121121111	
City	State				

THOUSANDS ENJOY THRILL OF PLAYING

Who Didn't Know a Note of Music



Over 700 000 people have studied music at home this easy way See how quack's gon can learn without a private teacher, without needless study and practice. This wonderful print and so ture method shows you just what to do, makes every more clear It starts you learning real tunes by note in first few leamore— you train to play by playing t

Costs Only Few Cents A Day

Best of all, the cost is susprisingly low averaging only a few cents a day for witatever conframent you choose. If you would abserted the ro play a musical transmission of you want to enjoy the pleasure and popularity that murls of

45

fers fill out and ma compose at more for fillustrated booklet and free print and picture temple. Instruments supplied when needed rash or credit 1 % School of Music. 31 Bronswick Bidg New York N Y (Forty third Year Est 1858)

checked be	ed of Music. Setted in music low Pease sen and picture samp	study part cul	ar w in th	e Instrument
Violin Cuiter	According Sexaphone Mandalle	Clarinet Trumpet Trambons	Stanja Ukula Other	
Nume				,
Street	!!**		.,,,	
City		State		

OL JUDGE ROBBINS





SHOULD THINK ANOTHER GOOD INDIAN NAME FOR RA. WOULD BE SMOKUM COOL' THAT'S RIGHT. PRINCE ALBERT SURE IS THE COOL-BURNING TOBACCO



IN RECENT LABORATORY "SMOKING BOWL" TESTS. PRINCE ALBERT BURNED



THAN THE AVERAGE OF THE 30 OTHER OF THE LARGEST-SELLING BRANDS TESTED_ COOLEST OF ALL!



PUT THE INDIAN SIGN ON TONGUE-BITE I PUT EXTRA-HOT SMOKES

OUT OF MY LIFE. PRINCE ALBERT IS SO EASY ON THE TONGUE. BURNS COOLER. IT'S NO-BITE TREATED



SURE PRINCE ALBERT SMOKES RICHER, TASTIER. THERE'S NOTHING TO SPOIL THE MELLOW GOODNESS OF PRIME TOBACCO



RAIS CRIMP **CUT** BANS ROLLING JITTERS, TOO. 'MAKIN'S' SMOKES SPIN IP EASY, FAST, SMOOTH NO SPILLING NO SKINNY ENDS.

TASTY? YOU BET!



PA.ISM



NATIONAL ĴΦŸ MOKE

SOLDIER 1941







hotos by Ralph Marse

A few days before he donned a uniform at \$21 a month, Larry Thompson was loading scrop iron at \$2 a day.

A ROOKIE GETS HIS FIRST TASTE OF ARMY LIFE

AWRENCE OTIES THOMPSON, of Norwich, N. Y., entered a new world over a recent week-end—a world of precision in which several hundred thousand young Americans will dwell with him within the next few months. On a Friday Larry was wrestling scrap iron in the freight yard of the Eric Railroad at \$2 a day; on the following Monday he was wrestling with the somewhat bewildering impact of army life at \$21 a month and "found."

The routine of his life, largely determined by his own preferences and impulses for most of his twenty-one years, had slipped suddenly into a mold whose detailed rigidity would have astounded the Medes and Persians and made Moses blink. It jolted Larry too, but he guessed that if the other members of Company L of the 18th Infantry could conform to it, he could too.

He got one good break. His first army job was noon dinner in the mess hall at Fort Wadsworth on Staten Island, N. Y., where the 18th Infantry, a part of the 1st Division, is stationed. At the dinner table laden with soup, fish, vegetables, bread and butter, apple tart, and coffee, Larry felt as competent as any of the other ten privates who sat down with a noncommissioned officer.

The fried fish, however, was followed by a lavish succession of wholly unfamiliar things. His bedding was in the basement

and Larry carried it up three flights to the bunk room to which he was assigned. He had had a room to himself at home, but in L Company barracks his home, like everything else, conformed strictly to government regulations.

It was sixty square feet of floor space and 600 cubic feet of air space. In the midst of his new home stood his iron bed, painted white. At the head of the bed was a metal locker for his heavy clothes. At its foot was a wooden rack for his shoes and a trun : for his small belongings. Larry discovered that regulations governed the making of his bed and the disposal of his belongings and were enforced through daily inspections. Twenty-nine other soldiers had their homes there, each with his sixty feet of floor space and 600 cubic feet of air space and each home more closely resembled its neighbor than those in a metropolitan auburb.

From the bunk room, still in his sweater and stacks, Larry went to the Quarter-master's office, where he received \$65.24 worth of new clothes and a lot of priceless information, both strictly regulation. He exchanged his \$1.98 oxfords for seven pounds of Size 7½ E shoes and his views on cravat-tying for the information that his black army tie must be tucked into the shirt, just below the third button.

Four numbers were confided to him with instructions to cherish them forever in his memory: his army serial number, 12,003,462; his company number, 131; his rifle number, 7285, and his clothing number, 3462. It was pointed out to him that the last four digits of his army serial number formed his clothing number.

The importance of bugle calls was impressed upon him until, aiready a little hazy in the head, Larry began to feel like an over-Worked echo of brazen notes, responding to Reveille at 6:15 a.m.; assembly at 6:30 s.m.; mess calls at 7:00 a.m., noon, and 5:00 p.m.; drill twice a day and Taps at 11:00 p.m. To add to his growing conviction that the abrupt transition from goas-you-please civilian life to the regulated life of the Army was a highly confusing process, Larry discovered

that he was a "John," in fact that all recruits were "Johns."

Within a few hours of his arrival at the post, Larry fell in with other Johns to listen respectfully to the Top Sergeant, Sam Lizer, a mighty figure of a man, who intoned appropriate passages from the Articles of War. This also, of course, is in accordance with regulations and is to inform the soldier of his rights and privileges and, more particularly, to warn him of the penalties for disregarding them. There is a reference to them in the oath of enlistment:

"I do solemnly swear that I will bear true faith and allegiance to the United States of America; that I will serve them honestly and faithfully against all their enemies whomso-ever; and that I will obey the orders of the President of the United States, and the orders of the officers appointed over me, according to the Rules and Articles of War."

His conscience laden with the warnings of the Top Sergeant, his memory burdened with numbers and bugle calls and bed-making, and his schedule of physical assets encumbered with the sixty-five separate articles of equipment issued to him that day, Larry's head was swimming, but there was more to come.

He was yet to learn that in the Army there is a way to stand, a way to walk, and a way to turn and all other ways are non-regulation and anathems. He got a glimmering of this the next morning on the drill field. With other Johns he got preliminary instructions in forms of address—how to salute, whom to salute, methods of



At the recruiting office Larry gets a thorough check-up of . . .



Sight-20/100 minimum O. K.



Heoring-20/20 O. K.



Nose-Negative, no obstructions



Throat and Teeth-O. K.



Larry arrives at Fort Wadsworth. His rail fare was paid by the Army

reporting, and courtesy to superior officers. At the afternoon drill, after a few limbering-up exercises, he was introduced to "the position of a soldier" and other preliminaries of close-order drill. "Belly in, chest out, head up, and heels together" were the elsments and it astonished Larry, a wellcoordinated young man, how frequently one or another of these elements eluded his control. Right face, left face and about face; column right, column left; right oblique and left oblique; right flank, left flank and to the rear, march; all these followed in quick order and by the end of the session Larry had learned the dynamic force of the command "March" and felt that he was doing as well as any of the other Johns.

T ALL had been simple enough, really, he reflected—just a method of getting a group of men from one point to another in an orderly manner. It certainly was a lot easier than throwing scrap iron around. When he tumbled out at Reveille, however, Larry wasn't so certain. He had aches in

muscles of whose very existence he had been ignorant all his life. The Army believes in the good old remedy, "the hair of the dog," however, and muscle aches, like everything else succumbed to regulations on the drill field.

No sooner, however, had Larry gained a little confidence in his ability to swing right or left at command than complications beset him anew in the form of a nine and a quarter pound Garand rifle and the manual of arms. He discovered that, in whatever position the rifle was to be held, there was just one way of getting it there: all shifts of the piece must be made with prescribed motions, properly spaced.

Right shoulder arms, present arms, order arms, present arms, trail arms, inspection arms, sling arms—the orders followed each other in bewildering succession. Someone told him that there were 200 different orders in drill and Larry put the man down at once as an ultra-conservative, given to under-

While he was resting between drills, Larry's corporal, John Bialobrzeski, who is known in the ranks as "Alphabet," gave him rudimentary instruction in the use of his first-aid kit and in making a marvelously compact pack of the tent pins, raincoat, blanket, socks, underwear, and numerous other articles which make up the field pack. When all have been properly assembled they make a tidy bundle that weight only twenty pounds, though they would cover a blanket if strewn about.

As one detail after another of the new life was mastered, including a good deal of army slang, Larry gained confidence and began to glow with the pride of a snake in a new skin, though he felt that in him the changes were more than skin deep. He could not only handle his semi-automatic Garand briskly, he could take it apart and put it together again. Without self-consciousness he began to refer to the cook as the "slum burner," to the bachelor officers' quarters as "Snob Hill" and to the mess

sergeant as the "K.P. chaser." Incidentally, kitchen police in L Company is not a matter of discipline, but of rotation.

AS HIS confidence in his ability to order his life according to regulations grew, Larry began to discover that there was a lighter side to army life. Leave could be obtained to visit the city and there was a good deal of entertainment to be found at the post at small cost in his leisure hours.

Larry began to look forward to the completion of his fourth month in the Army, when his pay would be increased from \$21 to \$30 a month. New vistas opened out beyond that, too; a corporal draws \$54 a month and a sergeant, \$60. That was something Larry hadn't figured on before. It hadn't occurred to him that a man might finish a three-year hitch with money in the bank, but he hadn't stopped to think that virtually all the ordinary expenses to which his \$2 a day had contributed in Norwich were settled for him now in advance. There was no rent to pay, no board bill, no clothes to buy, and medical and dental attention was free.

You earned your money in the Army, Larry decided, but, if you put your mind on it, you probably would be a lot more successful at saving it than you would be in Norwich. His final judgment was that Norwich had some advantages, but so did the Army. (Continued)









To be sure of a perfact fit, Larry tries



Civilian shoes—size 8
Army shoes—size 71/2
Civilian shoes—3 lbs.
Army shoes—7 lbs.

stable with eleven others he get no Army better again



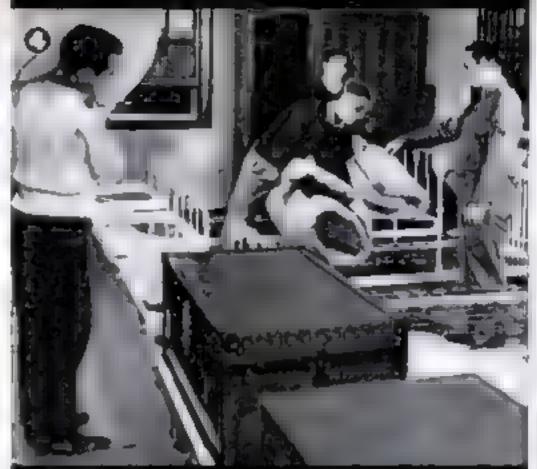
out he did get soup, fried fish, three vegetables, aread and butter, coffee, and fresh apple tert.



After dinner he had the job of toting his bodbding from the barracks supply room three flights



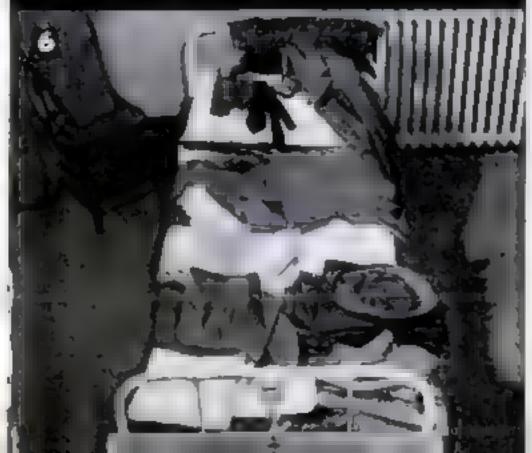
his had. At home he had a room to himself



New he has sinty square feet in a room with twentynine others. Making his had it a new experience.



Spreading his geor out on his bunk, Lorry found it totaled sixty-live items. With his civilian











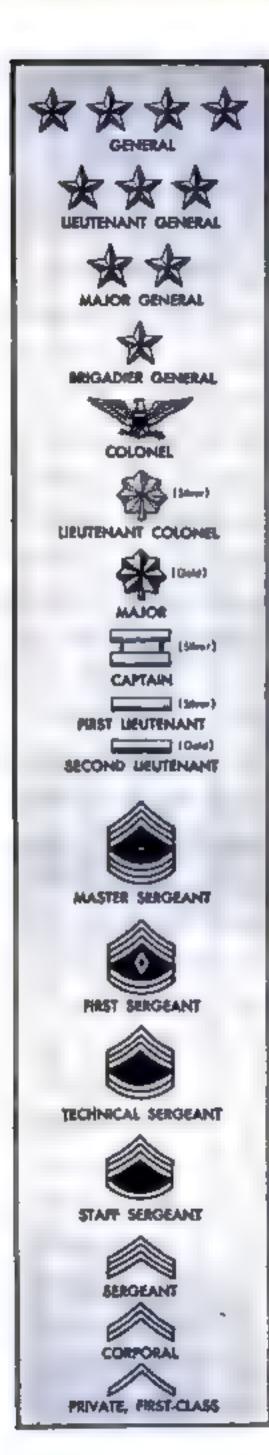


pack, a certridge belt, a senteen, buyonet and scalebard, and his nine-and-a-quarter-pound Garand rifle.



Eleven-wiclock tops brings the end of Larry's first Army day and the beginning of a brand-new life.





What U.S. Army's Insignia Tell You About a Soldier

AN you tell a colonel from a private by the insignia on his uniform? In the column at the left appear the insignia of every Army rank from a firstclass private to a general. At the right are the insignia for identifying arms or branches in the U.S. Army. The combination of these will tell you what you want to know about any soldier.

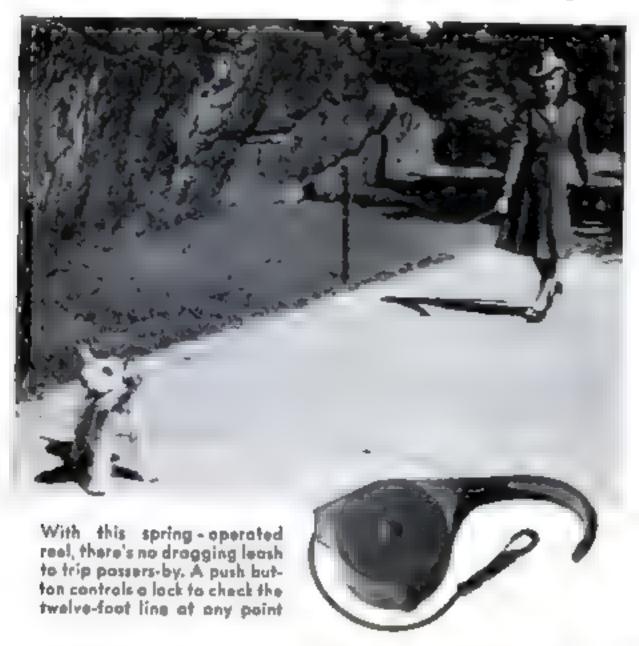


Commissioned officers wear insignia of rank on shoulder straps .. non coms and privates on sleeves.





Dog Leash on Spring Reel Plays Fido Like a Fish



A LEASH attached to a spring-operated reel is a new wrinkle for dog owners. Encased in a light but sturdy aluminum housing, the reel carries twelve feet of waterproofed leash strong enough to hold a great Dane yet light enough for use with a Pekinese. A hook forming part of the housing allows the owner to hold the device accurely. while the dog is free to run for a distance of twelve feet. As he returns nearer to his owner, the spring reel winds up the leash cord to prevent it from becoming tangled. A button-controlled lock makes it easy to stop the dog at any time as he is running out the leash, and to keep him in hand,

Individual Roasters "Home-Cook" Food for Restaurant

TO ASSURE his customers that "homecooked" flavor, Ros Gammon, Pittsburgh restaurateur, has installed a battery of eighteen electric roaster ovens of the type designed especially for home use. If the patron desires it, waiters will wheel an individual roaster to his table. where he may watch his meal being cooked. Another service made possible by the roaster ovens is delivery of complete meals to private homes or hotel rooms. The entire meal is prepared in a single roaster and delivered, roaster and all, to the purchaser. By leaving the meal in the roaster. the food is kept piping hot until it is served.



RADIO

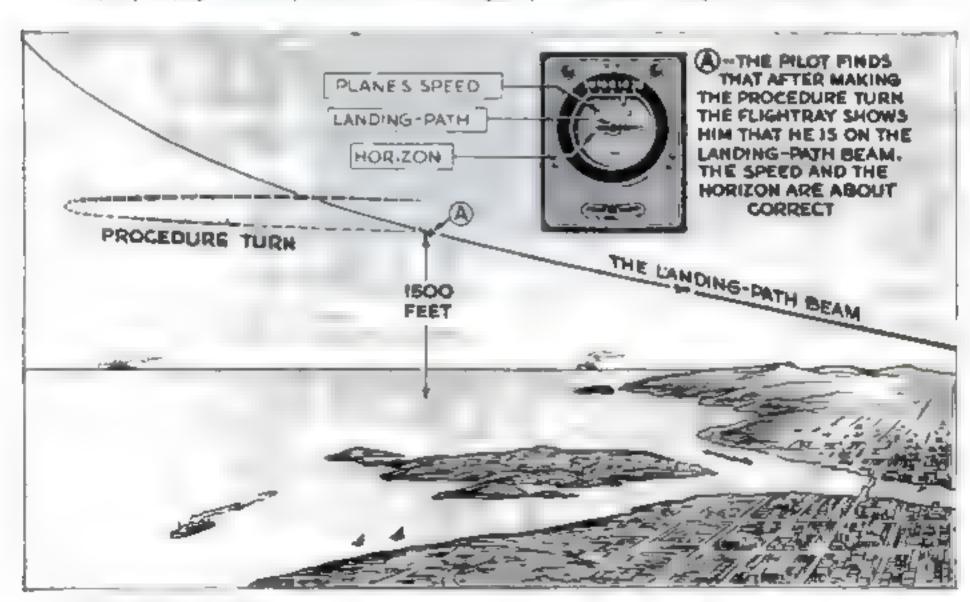
The Sperry "flying loboratory" used to test the Flightray

RADIO EYE GUIDES

Six essential airplane instruments are rolled into one by the Flightray, a remarkable device that enables pilots to take off, fly, and land in perfect safety with zero visibility. Tests conducted for several years by Sperry Gyroscope Company engineers have prepared for its debut as a standardized fitting for military and civil planes.

With dials multiplying upon flight panels of modern aircraft, and even spreading to walls and ceilings of the cockpits, a pilot's task in keeping track of them has become increasingly bewildering. Now the Flightray, a sort of radio eye, comes to the airman's aid by combining pictorially the readings of his gyrohorizon, directional gyro, altimeter, air-speed meter, radio compass, and radio landing meter.

Upon a circular glass screen with an airplane sithouette at its



How the Flightray guides a plane down the radio landing-path beam to a blind landing at an airport.

PLANES TO SAFE LANDINGS

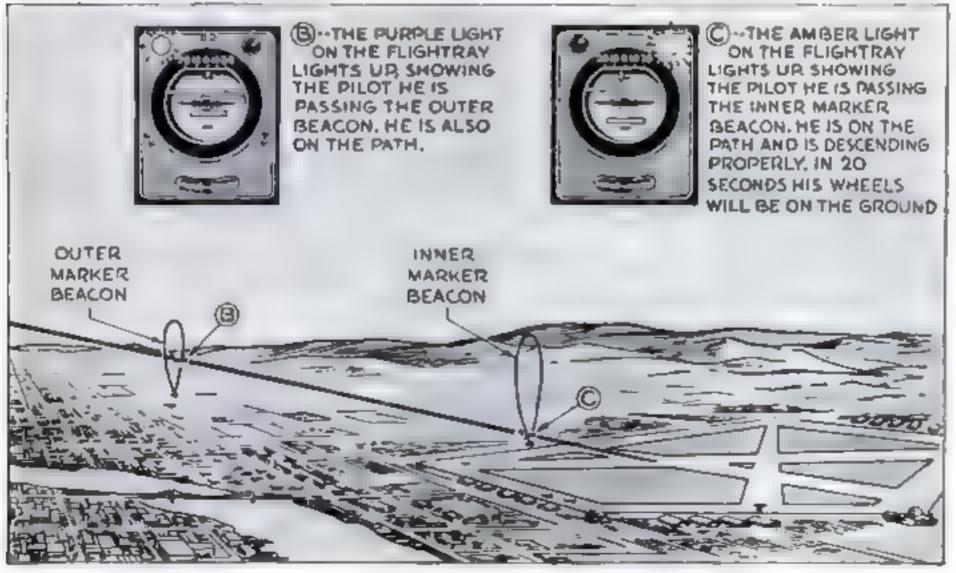
center, the pilot sees four luminous green symbols. A long horizontal line, his artificial horizon, shows by its movement whether the plane is climbing, dipping, or banking. A shorter horizontal line, rising and falling between two fixed marks, indi-

cates the plane's air speed; if it reaches the lower mark, the plane is at the point of stalling. A vertical line at the top of the dial moves to left or right according to direction of travel. Meanwhile a green circle wanders about the dial; by keeping it in the center, the pilot stays on a landing-path radio beam when coming down at an airport. A purple lamp at the extreme upper left of the panel lights up as the pilot passes the outer marker beacon; an amber lamp at upper right, as he reaches the inner marker beacon at the field's edge. A conventional bankand-turn indicator, at the base, completes the multipurpose panel.

A highly ingenious system based on movie principles combines the readings of master instruments on the cathoderay screen of the Flightray. Actually the four green symbols appear one at a time, but a rotating commutator picks them up in such rapid succession that they all seem to appear at once, with no visible flickering. Though unfamiliar at first, the resulting pattern becomes easy for an experienced observer to interpret at a glance.



On the single dial indicated above, the pilot sees at a glance the combined readings of six instruments



At each stage of the maneuver, the instrument holds the pilot on the path and indicates his progress

JANUARY, 1941

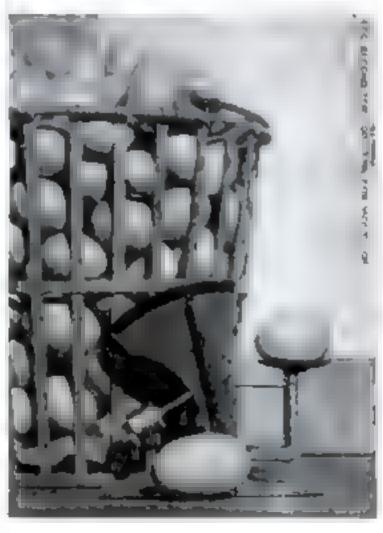
Two fried eggs from one shell. Housewives prize doubleyothers, but poultry breeders discourage their production



Floyd H. Moore with a pullet suspected of being too generous. Placed in a trap nest for observation, she has laid too many double-yolk eggs and will be sold. At right, a normal egg on the scale is contrasted with a two-timer

Double-Yolk Eggs Are Sold By the Dozen

OUBLE-YOLK eggs are an unusual by-product of the poultry farm of Floyd H. Moore, near Lancaster, Pa. About thirty dozen of the freaks are produced every week by the 2,000 pullets housed in Moore's acientific fivestory "hotel for hens," Prized by housewives because they pack a man-size breakfast in a single shell, they find a ready market and bring eight to ten cents more a dozen than ordinary eggs. Moore does not encourage the laying of double eggs, nor does he look with favor on a pullet which produces them too consistently, because his main business is selling chicks, and double eggs seldom if ever hatch live chicks. Any pullet is likely to lay one double-yolk egg in its lifetime, Moore says, but if he catches one of them doing it six or seven times, he disposes of the bird immediately, either destroying it or sending it to market.





Minstrels from Mars? No, They're U. S. Army Airmen

CROWDED around in a huddle, the seven weard faces that appear in the unusual photograph reproduced above are those of U.S. Army Air Corps pilots attached to a bombing squadron at March Field, Riverside, Calif., wearing oxygen masks of the type

developed at the Mayo Clinic, Rochester, Minn. (P. S. M., Oct. '39, p. 101). The masks, which leave the mouth completely uncovered and therefore do not prevent the wearer from talking, are used to supply necessary oxygen during high-altitude flying.

JANUARY, 1941 59



north to south. Lay the chart reproduced on the opposite page on its side, with the top pointing toward the polestar. Then locate the comet by determining where it will be on that date in relation to the three first-magnitude stars, Deneb in the constellation of Cygnus, Vega in Lyra, and Altair in Aquila, all of which are close to or in the Milky Way. Although it can be seen with the naked eye, a small telescope, field glasses, or even opera glasses will be of great help in locating and observing the large hazy object, whose tail should be long and conspicuous, streaming out northeastward. Scientifically, Comet Cunningham is of great importance. Astronomers will follow it carefully as it approaches the earth, swings around the sun, and returns into the depths of space,



Kings of

Diamond cutting has changed little with time, but a powered spindle now turns the cut stone that marks a gem for splitting



Polishing is done on machines like those long used in Belgium and Holland. An obrasive disk grinds two stones at once

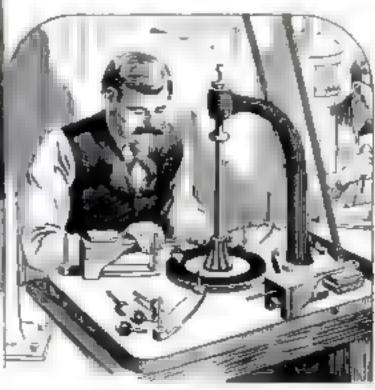
ngs of Diamonds



NKNOWN to most of the people in the United States, New York City has become the diamond-cutting center of the world. Before the German Army invaded the Low Countries, 24,000 cutters were employed in the homes and shops of Antwerp and Amsterdam. Now less than 400 cutters in New York comprise the largest remaining active group of men skilled in the art of creating a polished gem from a hunk of crystallized carbon

Fewer than fifty cutters have escaped from Europe to continue their work here, so there is naturally a severe shortage of labor in the industry. It takes years to learn diamond cutting, and two weeks to make a finished jewel of only one carat

In July, 1940, twelve times as many carats of uncut diamonds were imported by American firms as in any previous month. To meet the growing needs of Amerlcan cutters, American manufacturers are now making diamond



saws for the first time. Baumgold Brothers, the largest cutters in New York, with a staff of eighty men, have installed twenty-two of these American-made saws. The heart of the machine is a steel plate, four inches in diameter and .0035 of an inch thick, which spins at 3,500 r.p.m. The edge of this plate is coated with diamond dust and olive oil. Such a saw can cut through about one carat of diamond in eight hours.

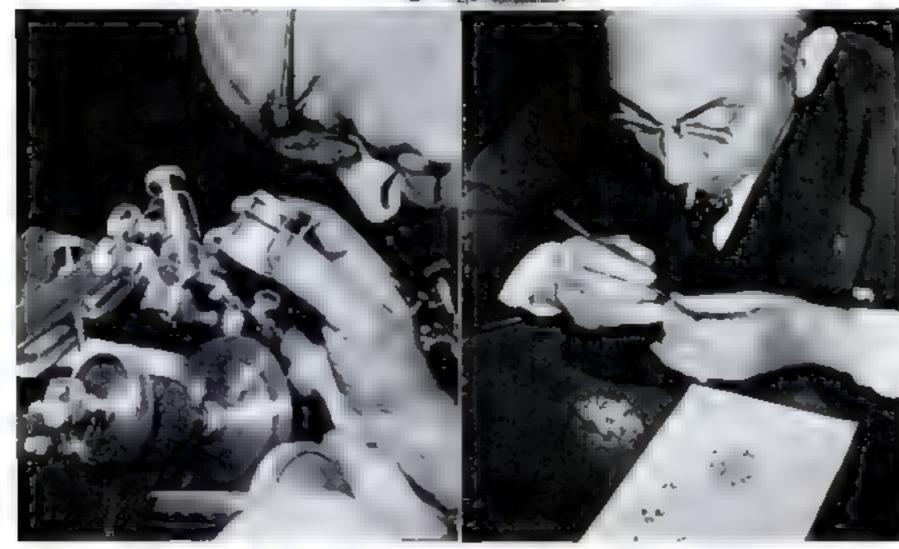
American industry also has aided the diamond cutters by making it possible for them to keep their saws running continuously. Cutters have known for years that a diamond saw won't work in wet, muggy weather. But by air-conditioning their sawing room, Baumgold Brothers have licked the dampness and increased their sawing capacity by thirty percent.

While diamonds are prized for their beauty and rarity, only twenty-five percent of those mined become gema.

The rest find their way into industry, where they are
used, among other things,
for truing grinding wheels
of emery and carborundum,
drawing wire, sawing and
drilling stone, and metal
etching. The demand for
industrial diamonds is increasing rapidly as the defense program speeds up.

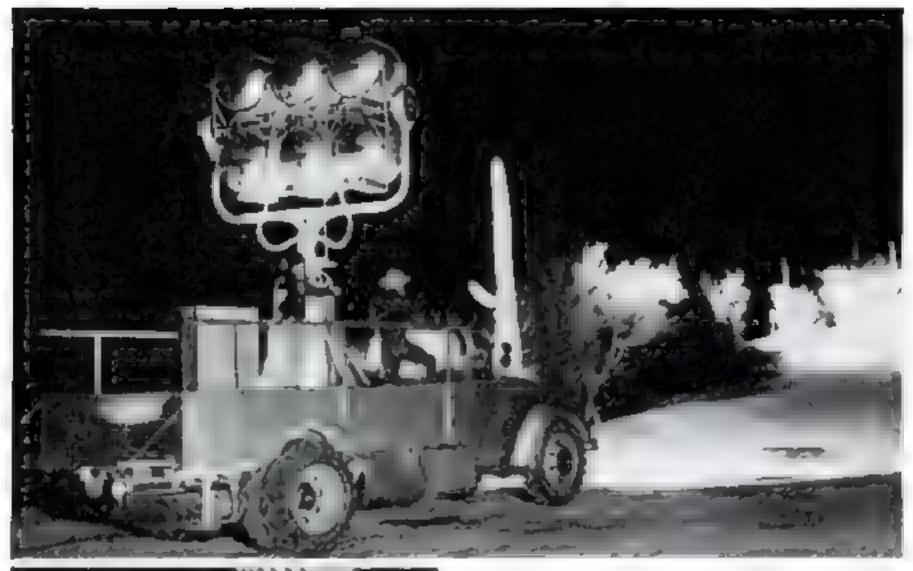


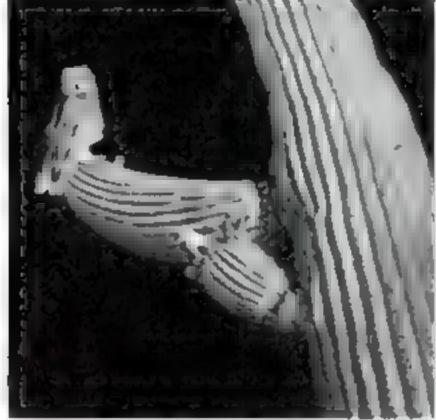
To split a diamond, the "cleaver" places a flat piece of steel in a nick marked in the stone, and taps it with a metal rad The result is a clean cut along a line of cleavage



American manufacturers now make diamond saws. This steel disk is coated with diamond dust and oil

Examining finished stones. Four hundred cutters in New York have almost a monopoly of their craft





What an awl looks like when it's hooting mod and cought in the glare of huge lights on the truck

Truck Carries Floodlights To Photograph Wildlife

To BLIND or bewilder nocturnal birds and animals in the desert around Tucson, Arix., long enough to photograph or capture them, an American Museum of Natural History expedition equipped a truck with a floodlighting plant. Its battery of lights totaling 45,000 watts, operated on power generated by a 110-horsepower Diesel motor, provided enough light to allow color photographs to be made at night. Richard Archbold, who has led expeditions to Madagascar and New Guinea, headed the field trip. The party spent three months charting the wild life of the region. At the left is an indignant owl, momentarily baffled by the brilliant beams of the lights.

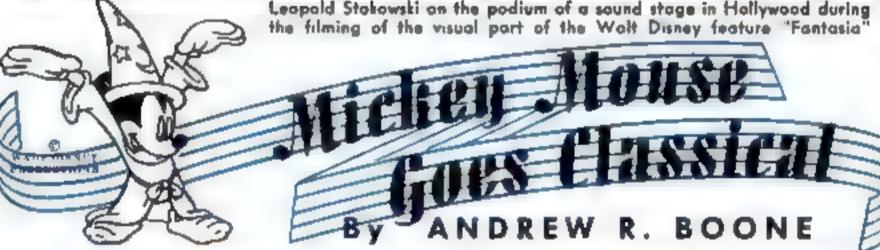
Bottle Sprays Solution for Treating Burns

BURNS can be treated easily and quickly by spraying the injured part with a solution contained in a handy bottle. All that is necessary is to point the nozzle at the burned area and press a lever attached to the cap. Volatile ingredients in the solution produce the pressure necessary to eject it from the bottle.



How soothing liquid may be sprayed on a burn to relieve pain





moving pictures to bring greater realism to the screen. Accompanying Walt Disney's newest Technicolor creation, "Fantasia," in which Mickey Mouse and a host of new companions perform to the rhythms of classical music, this latest Hollywood invention made its first public appearance a few weeks ago at the Broadway Theater in New York.

Moving sound is literally that, Four circuits using sixty loudspeakers make it possible to chase music right around an

OVING sound has been added to audience, out of the acreen and back into it, or make notes die away into infinity overhead. The sound equipment alone fills thirty-five packing cases. For that reason "Fantasia" will be screened only in selected metropolitan theaters where the speaker systems can be installed.

> Two years of painstaking work by Disney, R.C.A. engineers, and 1,000 Disney assistants went into "Fantasia," which is really a pictorial interpretation of seven great compositions. The music is by the Philadelphia Symphony Orchestra, under



Disney explaining the story to Stokowski and to Deems Taylor, the music critic, who also helped Mickey Mouse to crash the realm of the classics



In the basement of the Philadelphia Academy of Music, technicians control the recording of music from different sections of the archestra

the baton of Leopold Stokowski. Deems Taylor, music critic and composer, aided in making the production.

Behind "Fantasia" lies Walt Disney's desire to always give the public something new and better than what they have known in the past.

"We know," he said recently, "that music emerging from one speaker behind the screen sounds thin, tinkly, and strainy. We wanted to reproduce such beautiful masterpleces as Schubert's 'Ave Maria,' and Beethoven's Sixth Symphony so that audiences would feel as though they were standing on the podium with Stokowski."

To achieve this effect, he knew that means must be found to spread sound throughout the theater, that "point sources" must be concealed from the ear. The sound recordings must be such that each and every instrument or voice would be heard clearly and distinctly in its proper proportion to the whole orchestral effect.

The recording alone for "Fantasia" took almost eighteen months. Approximately 3,000,000 feet of sound track from individual takes, prints, and remakes were condensed into the final 10,778-foot, four-track negative.

Neither Disney nor the engineers knew just where the experiment would lead when the 110 members of the orchestra first took their places on the stage of the Philadelphia Academy of Music early in April, 1939. Thirty-three microphones faced the musicians. From them nine channels carried the music to nine recorders set up in the basement of the building. Seven channels transmitted sounds from individual groups of instruments such as the wood winds and the violins. The eighth caught the com-

plete orchestration, while the ninth carried the beat of a telegraph instrument which later enabled the animators in Hollywood to fit the action of "Fantasia" to the tempo of the music.

Seven weeks Stokowski and the orchestra labored. All that time a second director faced the recording instruments, guiding the recording on film of each passage. From a duplicate score he brought choirs in and out, stepped up solos. Engineers tuned

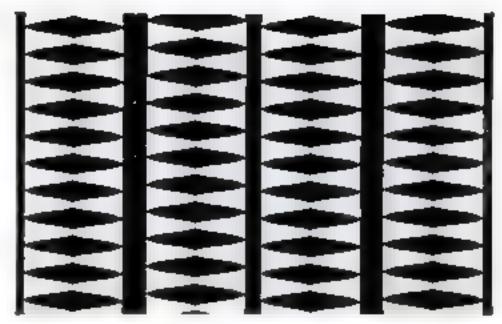
volume controls, guided by oscilloscopes which told them just how much sound was coming through their machines.

Exactly 483,000 feet of sound track were recorded in forty-two days. Cans of film were shipped by air to Holly-wood for processing. After that retakes were made where necessary to obtain exactly the desired tonal combinations of choirs, soloists, and instruments.

Then came the problem of mixing these sound tracks into one realistic whole. First the engineers tried multiple speakers fed by a single sound-transmission system. That spread the sound over a wide area, but when the characters spoke, the synchronization of words and lip movements was lost.

There were further experiments before the producers were satisfied. The
solution was finally found in combining
the nine tracks into four; three for "entertainment sounds," such as voices,
music, and special effects, and the fourth
for a control frequency governing the
volume of the other three.

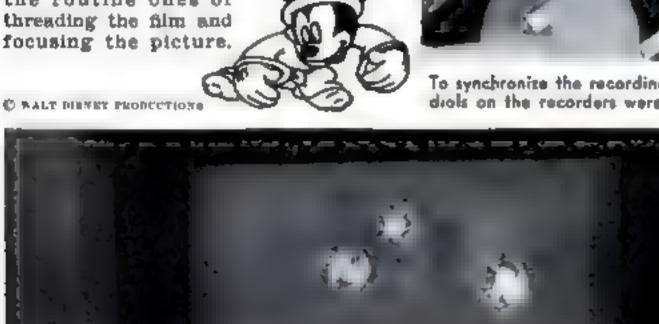
Operators in the projection booths of theaters where "Fantasia" is presented will face no unusual complications. Their problems will be the routine ones of threading the film and focusing the picture.



This is how a sustained note looks on the four film tracks that create the novel effect of "moving sound"



To synchronize the recordings of three program tracks, drols on the recorders were linked with endless chains



Technicians at a re-recording console merge the sounds from the seven tracks made at Philadelphia

Inventors Begin Search

Secret Weapon

NATIONAL COUNCIL HUNTS NEW IDEAS FOR DEFENSE



J. Robert Fish demonstrating an antiaircraft racket which is said to find its target by sound. At the left is W. S. Hale with his "mystery gun" that shoots balls by compressed air

By MYRON M. STEARNS

HE greatest American inventors alive today are organizing a country-wide search for a secret weapon.

It may come from a tiny workshop in a country lean-to. It may come from the benches of a great research laboratory. It may be the brain child of an already-famous scientist, or the ugly duckling of an unknown inventor. It may be the result of long, painstaking experiment, or the result of an accident. It may concern a rocket ship that will change all aviation-or a cheap, light substitute for lead that can be as readily cast and as easily bent.

To find that priceless idea—to mobilize American genius in the development of all ideas that will make this country a more formidable adversary—the United States

Government has created the National Inventors' Council. Its business is to stimulate, find, and appraise suggestions, ideas, and

devices that may be useful in time of war.

To a greater extent than ever before, war has become a contest of inventors. Fighting in three dimensions, foreshadowed twentyfive years ago by the first war planes and the submarine blockade, has now become an accepted fact; it is still so new that nobody yet knows what developments may change it completely. A single idea may bring victory to one side or another.

That is where the National Inventors' Council comes in. American inventive brains are recognized as the best in the world. Americans were the first to fly, first to build seagoing submarines, first to put armor on warships and change the navies of the world, first to put armor on automobiles and create modern tanks, first to "fix" nitrogen, first in mass-production methods.

Every inventor in this country, amateur or professional, is being urged to send in to the Inventors' Council whatever designs he has been experimenting with, whatever devices he has already worked out, that may be valuable from the standpoint of defense. One may have found a way to keep metal from heating rapidly, that can be used in the manufacture of rifle barrels. Possibly another knows of some substitute for gelatin, that will help give muscular strength in an emergency. The National Inventors' Council, at the Chamber of Commerce Building, Washington, D. C., can make them available for the whole country.

The N.I.C. will not pay for ideas, nor have anything to do with their being patented. It has no connection with the United States Patent Office. Nor will it give advice as to whether or not an idea should be patented; that is the sender's business. But suggestions or devices found useful will be turned over to the Army or Navy. or whatever government department may decide to use them, and will then be negotiated or paid for in accordance with the regular custom and rate of that particular department.

No auggestions will be considered that do not relate to defense. All suggestions must be in writing, in English, each one separate. supplemented by drawings if necessary. Senders are advised to keep duplicates of their suggestions, signed and dated, preferably in the presence of witnesses. Models, and materials of all kinds such as chemical substances, are to be forwarded to the Council only if requested.

A certain amount of data is also necessary: Sender's name and address. Is the suggestion in use, or merely an idea requiring further development? Has it been patented? Has a patent been applied for? Is the sender the sole inventor? Has be

> From the drawing boards of the notion's inventors, defense suggestions will flow to the Washington offices of the National Inventors' Council, some of whose members are seen below at a meeting in the Department of Commerce

assigned any rights? Is he acting as owner. or agent? Has the idea been divulged to any foreign government?

Nothing should be sent in that has already been submitted to any other government department.

Ideas that state only objectives, instead of a means of accomplishing something, are not wanted, "A bomb that will follow an airplane around until it hits it" is no use to anybody unless the sender tells how it can be done.

Also, ideas concerning things of which the sender is ignorant will, obviously, be worthless. A device that works all right on a table might be useless on the wave-swept deck of a battleship, Creators of ideas outside of their own lines of knowledge are advised to discuss their inventions with an expert in that field, whom they can trust, before submitting them.

There is no time to be lost. Production of next year's airplanes is already under way;



TWO DOZEN DEFENSE NEEDS THAT INVENTORS MAY SUPPLY

- 1 A coment for fastening rubber to metal,
- 2 A finish to which ice will not stick, for use on planes and windshields.



3 A means of dispelling fags over airports to permit operations in any weather.



- Spork plugs with points which will neither burn under full-load engine operation, nor foul at idling speeds.
- 5 Methods of making building materials, such as lumber and plywood, non-inflammable.
- 6 Lighter-weight batteries for portable radios to make them still more partable
- 7 Temperature indicators for use in molten steel in furnaces and ladles.



- 8 Storage batteries without a corresive electratyte, which would require no attention.
- 9 A device to use waste heat energy in air-
- 10 Tools for inexpensive welding of



- 11 Instruments for more adequately measuring the effectiveness of various lubricants.
- 12 A fuel system for aircraft that will compensate for the drop in pressure at high altitudes and avoid vapor locks.

- 13 A form of cost from that will bend under stress instead of breaking.
- 5tainless steel that is capable of resisting a pressure of 150,000 pounds per square inch without suffering deformation.
- 15 Heat and wear-resisting steel bars that machine easily to make gun barrels.
- 16 An acid and heat-resisting alloy which will cast readily and machine easily.
- 17 A method of producing full-color prints from original transparencies in a single operation.



- Metal alloys that will resist pitting by electrical arcs, for switches.
- 39 Soldering flux that will not cause corrector of soldered parts in service.
- 20 A solder that will work on aluminum as well as lead solder now does on tin.
- 21 Ballers which will not accumulate slag.
- 22 Derable point for ship's bottoms.
- 23 Photographic enlarging paper to reproduce accurately tones in negatives.
- 24 Material similar to Formica or Micarta, which will not absorb mostture, to make internal pump parts.









DRVILLE WRIGHT, who, with his prother Wilburg built the first successful flying machine, is a member of the Council file investion bear world in the science of world

FRED MORRELL ZEDER, vice president of the Chrysler Corporation A voteron automobile man, he was chief engineer for the Studebaker Corporation before joining Chryslet, Grew up with the automotive industry.

WILLIAM D. COOLIDGE, directors in General Electric Research Labourntaries; A physical chemist, he invented and applied ductile translation. Another achievement is the invention of an improved X-ray tuber

ideas that may be submitted now for improved planes, tanks, listening devices, explosives, guns or submarines cannot get into production for months or years ahead. The idea of protecting automobiles with armor and mounting guns on them was already seven years old in 1914. but the first tanks did not make their appearance in actual battle until near the close of the war. Before the armistice in 1918. devices for the radio control of torpedoes and even aerial bombs were being experimented with, but they're not perfected yet.

A lot of people have realized the value of getting American genius to work in these days of world upheaval. Among

those who discussed the matter last summer were Lawrence Languer, prominent New York patent attorney, and his friend Thomas Midgley, inventor of ethyl gasoline. They went to Conway P. Coe, United States Commissioner of Patents. Their plan sounded good. The three of them went to Harry Hopkins, then Secretary of Commerce, and with the President's approval the Inventors' Council was hatched. Men of outstanding ability and character, whose names and achievements alone inspire confidence, were called in. Charles F. Kettering



CHARLES F. KETTERING worldfamous inventor and president of General Motors Research Corporation, is chairman of the council

accepted an appointment as Chairman. Commissioner Coe, Languer, Dr. Midgley, Dr. Fin Sparre, Orville Wright, Dr. William D. Coolidge, Dean Frederick Feiker, George Backeland, Fred M. Zeder, Watson Davis, and Dean Webster N. Jones of Carnegie Tech agreed to serve with him.

These dollar-a-year topnotchers are not merely a "front." Each is the head of a technical subcommittee in the field of his own special knowledge. That means a lot of work.

Two high-ranking officers are also serving with the council: Rear Admiral Harold C. Bowen, representing the Navy, and for the War Department, Major General J. O. Mau-

borgne, Chief Signal Officer of the Army since 1937.

If the danger of our going to war is finally averted, or if we go to war and come out all right on the other side, the Inventors' Council may become a tremendous force for the advancement of civilization. Just as nitrogen can be used either for explosives or for fertilizer, nearly all devices suitable for war can be doubly effective for peace. Instead of using mosquito planes for dog-fights, we may be hopping into them, as we do into autos today, to visit the neighbors.







CONWAY P. COE, United States Commissioner of Patents shrings on the Council a wide knowledge of inventions and inventors. In spite of his membership, the Council has no suspection with the Patent Office.

LAWRENCE LANGNER, potent at the many Author of many technical articles on potent laws and their applications. He is also interested in the theolet and it the pusher of the annual Suzanne and the Elders.

FREDERICK M. FEIKER, down of the George Washington University School of Engineering, for throat years editor of "Electrical World." He was Assistant Sucretary of Commerce in the Hoover Administration



What Is the Outlook for Aviation in 1941?

By C. B. Allen

RESENT indications point to 1941 as a boom year in American aviation. On both the military and civil aeronautical fronts, prospects could scarcely be brighter—thanks to factories glutted with British war orders and American national-defense contracts and to the Civil Aeronautics Administration's pilot-training program in the universities and colleges.

The warplane building program is scheduled to go on at ever-increasing tempo until the second quarter of 1942. By that time, the National Defense Advisory Commission estimates, the industry will have produced (since July 1, 1940) some 19,000 aircraft for our own Army and Navy, plus 14,000 for the Royal Air Force; simultaneously, it will have built up its production capacity to the point where it can turn out fighting planes at the rate of 50,000 a year.

Whether there will be a continuing market for any such production, at home or abroad, is a question the experts seem willing to leave unanswered until 1942. Actually, the combined aircraft requirements of the Army and Navy, as presently conceived for Western Hemisphere defense purposes, is less than half the 50,000 airplanes envisaged by President Roosevelt in his "total defense" message last May.

The C.A.A. program lays claim to no military significance beyond that of creating a reservoir of air-minded youth, trained in the rudiments of flying, from which the Army and Navy
can draw candidates for their specialized training. This is no longer a
"civilian theory"; it already has been
transformed by the demand for military pilots into an everyday fact and
one which seems to be working to the
great satisfaction of the two services.
Likewise, the Army appears to be well
pleased with its now well-established
system of contracting with civilian flying schools to give the majority of its
air cadets their primary training.

This experiment, and the far more comprehensive one of the C.A.A. in carrying out its pilot training program through the existing facilities of civil aviation—the struggling flying-service operators on thousands of airports all over the country—have been a tremendous boon to the industry. What is more, they may be the means of its salvation in the inevitable let-down days ahead when the present "emergency" passes, when the expanding aircraft factories of today come to an end of their war orders and a tapering-off of their defense contracts. Perhaps, when that time arrives, the thousands of young men and women whom the C.A.A. has taught to fly will constitute auch a market for civil aircraft that a thriving industry can be kept alive without the stimulus of abnormal military buying.

Turning Out the Planes By Arthur Grahame

"WE HAVE big orders and we are getting the materials we need to fill them. We are expanding our plant, installing new machines, training new workers. All the other airplane manufacturers are doing the same thing. Mass production will

become a reality just as soon as these new

Here are same of Uncle Sam's new bombers.

Aircraft factories are humming to produce 19,000 fighting planes for our own Army and Navy, and 14,000 for Britain, by 1942

facilities can be put to work. And with mass production we'll get the job assigned us done on time."

That's the way the aircraft-production situation looks to an official of the Glenn L. Martin factory, Baltimore, Md.—a man who is on the industry's firing line in its battle against time to build up our inadequate air defenses. How does it look in Washington, G.H.Q. of the colossal defense program?

Right now the country's aviation experts are devoting all their time to turning out the 33,000 bombers, dive bombers, and pursuit ships—19,000 for our own Army and Navy and 14,000 for Great Britain—which they have estimated American factories can produce by April 1, 1942. (Continued)



3d Torpedo Squadron (Navy)



let Observation Squadron (Navy)



6th Scouting Squadron (Navy)

Plant expansion, financed wholly or in part, directly or indirectly by the Government on terms which protect the manufacturers against loss when the present emergency is over, is going ahead. The Curtiss-Wright Corporation is building new plants near Columbus and Cincinnati and is enlarging its Buffalo, St. Louis, and Paterson, N. J., factories. Similar expansion has been accomplished and is still under way at United Aircraft Corporation's Pratt & Whitney engine and Hamilton Standard propeller divisions, in East Hartford, Conn., and at its Vought-Sikorsky airplane division at Bridgeport, Conn. The Martin company is increasing its floor space from 1,250,000 square feet to almost 4,000,000. North American Aviation is supplementing its Los Angeles plant with a new one in Dallas, Douglas, Boeing, Consolidated, Lockheed, Vultee and all the other companies are making planes for the Army and Navy.

Building aircraft engines is a more complicated job than turning out the

airplanes themselves, and engine production cannot be increased with the same rapidity as that of aircraft. Already the public has seen the spectacle of combat planes coming off the production line days and weeks ahead of the engines to be installed in them; of motorless Curtiss P-40 pursuit ships collecting under circus tenta and other temporary shelter at Buffalo, waiting for their Allison engines; of Boeing flying fortresses cluttering up the airport at Seattle waiting for Wright Cyclone motors, or being stripped of their power plants after flying to an Army field so that the engines could be taken back to the factory and installed in a succeeding bomber.

Seen in flight, the modern military sirplane has a look of sleek simplicity, yet it is one of the most complicated weapons man has ever evolved. Its 14,000-odd parts come from several hundred different sources of supply; the knowledge and skill of scores of sciences and crafts go into it.

In the Martin plant, after the design of a new plane is approved, it is

These Army and Novy fighters, bombers, dive bombers and



96th Bombardment Squadron (Army):



99th Bombordment Squadron















drawn out, full size, on coated aluminum-alloy sheets. When every detail is complete, the sheets are photographed by a huge camera of special design, which is later used as a projector to reproduce the drawings, full size or to any desired scale, on any material.

Tool-design engineers decide on the machine tools and dies needed to make the plane's many parts. Dozens of special machines cut and bend metal into the shapes called for by the drawings. A metal-stretching press forms the whole belly of a bomber fuselage over a wooden pattern in a single quick operation-it would take two men six hours to do that job by old, bumping hammer-and-file methods. A big router shapes out a dozen sheets of duralumin at a time.

Airpiane-factory assembly lines do not move in the continuous fashion of automobile assembly lines, but rather by stages. The standards of workmanship are too high and the stake of human life too great for the speed of automobile production,

As parts move from stage to stage on the production line they are joined together in sub-assemblies until at last they become wings or tails or nose sections. For the sake of accessibility, the whole front end of a bomber fuselage is built in halves, with controls and other interior fittings installed, and these haives are then riveted together. As the various sections of the plane near completion, they converge in a final assembly line and are joined together as a complete ship. The engines are then installed, fuel and oil lines and electrical wiring are booked up, controls are connected, and the airplane is ready for flight.

The job of supplying the United States and its friends with 3,000 planes a month is a prodigious one, yet "Big Bill" Knudsen, the Defense Commission's production coordinator. believes that it can be done. He has inspired the confidence of the entire aviation industry by cutting red tape and eliminating lost motion, until now even the industry's professional pessimists see light ahead.



2d Wing (Army)



8th Pursuit Group (Army)

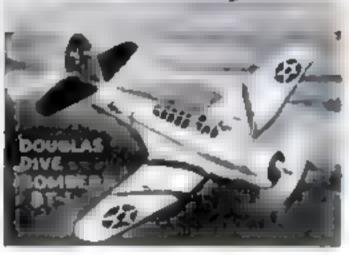


30th Bombordment Squadron (Army)



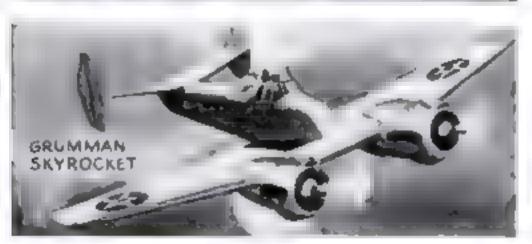
patral planes are the latest additions to the U.S. air forces -







3d Utility Squadron (Navy)







5th Fighting Squadron [Novy]





Canada Rallies Her Cat Men

NORTH WOODS TRACTOR DRIVERS SUMMONED TO RUN WAR TANKS



By HICKMAN POWELL

IFTY degrees below zero, a blizzard blowing, and 200 miles to go. Over frozen muskeg bogs, down creek beds, and up through the bush over rugged moraines go the drivers of the tractor trains, all through the wild Canadian winter, freight-

mushing, which in recent years has conquered the swampy wilderness for heavy traffic, a man has got to be tough. But especially he's got to be good. That's why

he's sure to make a real tank soldier.

The far north's new breed of musher is called a cat-skinner. Up around God's Lake and Hudson Bay there aren't so many catskinners this winter. They've been joining the Canadian Army in droves, and as soon as they can get a proper rig of machinery they are figuring on starting for Berlin. After all, a tank is nothing but an overgrown, armored cat—with some teeth in it.

At his peacetime job, the cat-skinner rides the cab of a six-ton Caterpillar tractor over trails marked by poles in the drifted snow, with six sleds and a caboose behind and maybe fifty tons of precious freight. On his cat he carries a spare radiator and six barrels of gas. He uses fuel oil for antifreeze and he keeps his engine running for five or six days at a stretch. If it breaks down on him, he rigs a tent over his cat, installs a stove, takes a chew of tobacco and a monkey wrench, and fixes things right on the spot. When he starts out with a cat train, he gets there and he brings it back.

You'll find these north-country men today in a sandy wilderness of tar-paper shacks called Camp Borden, up between Lake Simcoe and Georgian Bay, north of Toronto—tinkering with those 200 World War tanks which the U.S. Army sent to Canada a few

weeks ago.

With them are cat-skinners from the western construction crews, drag-line men,

clamshell men, buildozer men. And hundreds of boys from the farms of Manitoba and Saskatchewan, who know their gas engines and Diesels too. If a lad is tractoring a section of wheat land twenty miles from the railroad, he can't call the garage when something goes wrong. And when that lad goes to town, he drives his own jallopy.

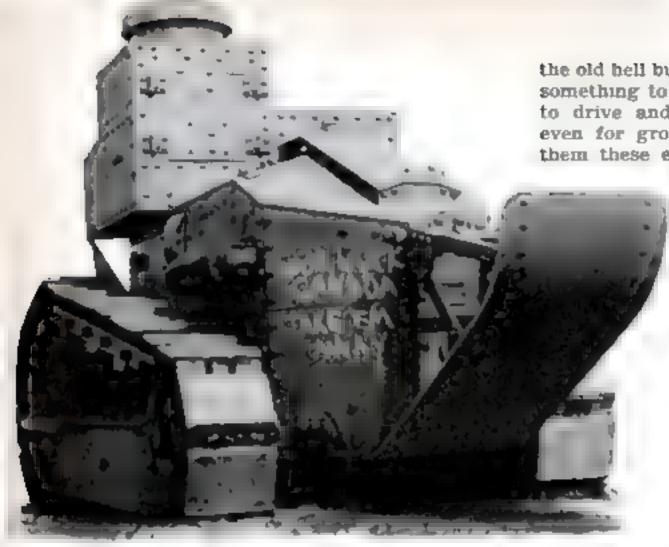
One look at those old tanks we sent to Canada would give Hitler a belly laugh, but another look at the men who are handling them would tone it down. Just let the R. A. F. and London hold out long enough for the tank factories to get going, and the Panzer divisions will have something to tangle with.

Take the Fort Garry Horse, for instance. That's a cavalry regiment from Manitoba, named for the old frontier post which became Winnipeg. In the last war it dashed behind the lines and put a German field battery out of action,

The boys of the Fort Garry Horse get their first look at a batch of old U. S. tanks with a mounted charge against withering machine-gun fire, one of the great cavalry exploits of modern war. It was a sad, sentimental day for Col. Samuel J. Cox and his older officers when, in September 1939, the Fort Garry Horse bowed to the inevitable. mobilized as a mechanized outfit, and recruited up to war strength with tractor men, garage mechanics, and cat-skinners. But it was a sadder winter when men who had volunteered for mechanized duty found that they had no machinery to work with, By the end of the summer (spent guarding German prisoners captured in the mechanized blitzkrieg abroad) these men were so machinery-hungry that they'd have started picking their wrist watches apart if something hadn't happened.

That something was the sale of the old American tanks, which made it possible to bring together the Fort Garry outfit and three other tank regiments at Camp Borden and set them up as Canada's first armored-vehicle brigade. Obsolete though





One of 200 U.S. tanks for Canada bears a message of good will

the old hell buggies were, they gave the men something to work on, a means of learning to drive and navigate cross-country, and even for group maneuvers later on. With them these empty-handed regiments could

be turned into going concerns.

Bright and early the Fort Garry horsemen were on hand at the depot to get their quota of forty tanks. Experienced tank men, there to show the troopers what to do, just stood by with surprised looks on their faces. The cavalrymen hitched up a few hose connections, poured a little gas in the vacuum tanks, twisted the cranks, climbed aboard, and simply drove the cats away.

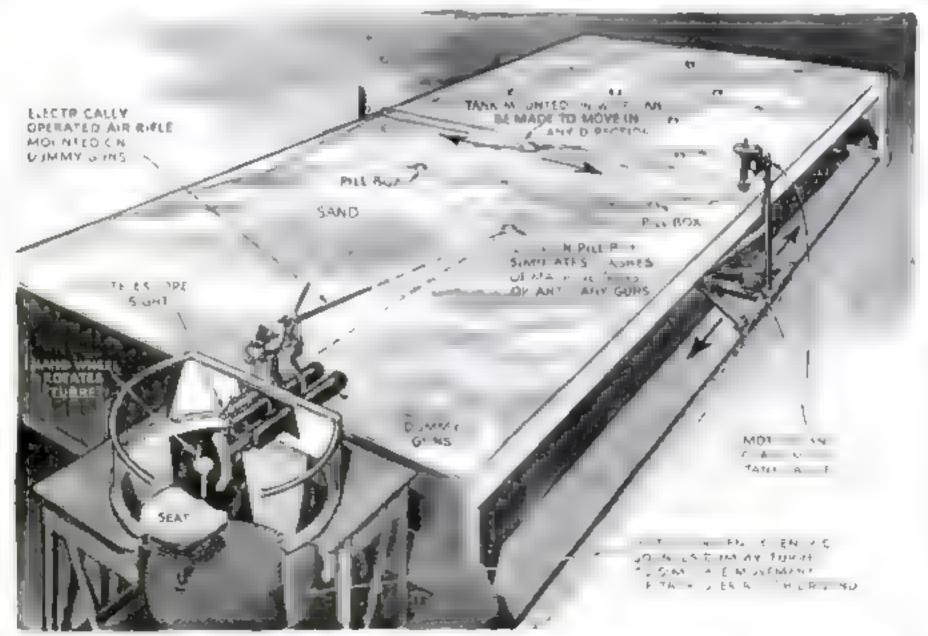
"Ride 'em, cowboys!" somebody cried—and they did.

These little six-ton, twoman tanks (American-made

BOUNCING "RYPA" TRAINS CANADIAN TANK GUNNERS

FOR teaching gunnery at the Canadian tank school at Camp Borden, Ont., a training device called a "rypa" simulates the roll, yaw, pitch, and alternating oscillation of a tank in action. Looking through a tele-

scopic sight, the gunner turns the revolving turret and aims a dummy machine gun at moving targets on a sand-pit range. An electrically operated air rifle, aimed with the machine gun, shoots lead peliets.



Handling a machine gun in a hell buggy is like shooting ducks from a boat. This device teaches the knack

on the Renault model) were tough-looking babies, weathered for more than twenty years in a parking lot at Fort George G. Meade in Maryland, many of their hulls and turrets pitted with machine-gun marks, presumably from the last war. They clattered along on wide steel plates with heavy lugs (a far cry from the flexible chainlike links of speedy modern tracks) which slapped on the ground and limited speed to six miles an hour. But the engines and running gear were O.K.; they had been greased up well when put away. And if the old-style tracks were good for only 150 miles on these sands at Camp Borden, that was fine. So much more repair work to be done in the winter

Back at their own quarters, the Fort Garry boys went to work. Within three days, twenty-five of those forty tanks were out in line, purring like kittens, and the rest were well on the way.

The boys clattered up and down in the open spaces among the barracks. For a man who has driven a car there are only a few things to catch onto. The controls are almost the same as a car's, except that you practically sit on the floor and instead of a wheel you have two clutch levers, one for each track. Pull back the right lever, it disengages the clutch of the right tread and turns you in that direction. Unlike most cats, a still

harder pull brakes the track, and you make a hairpin turn. It is in rough country that the cat man's skill comes into play. There the novice can easily tip over a fast tank, perhaps kill his passenger if the turret above is open. But the experienced man will instinctively spin her when she tips, quickly turn her nose straight down the grade.

Anyway, the boys took to the equipment like ducklings to a mud puddle. And old horse soldiers happily realized something: the Northwest still breeds good horse riders; but the same lads are part of a whole generation which has grown up in North America since the last war, a generation which practically cut its teeth on a spark plug and was weaned on a carburetor.

That is something worth remembering in these gloomy war days. Since the disasters of last May, all of us have been centering our thoughts on aviation, on assembly lines,



"Worthy"-Col, F. F. Worthington

The commander of Canada's first tank brigade takes a look at one of the U.S. jabs

machine toois, and craftsmen who can split a thousandth of an inch. These things are all important, and military aviators have to know their trigonometry. But when armored vehicles are produced, it's

going to be the back-yard and the backcountry mechanics who fight with them. If Britain is to win, there will be more war on the continent. And whether they take off from the Near East or from a beach-head on the Channel, that's when you're likely to hear more of Canada's cat-skinners, and of their salty, peppery, pint-sized commander, Col. F. F. Worthington.

This is one of those sad, pathetic tales of unpreparedness, though it now may have a satisfactory ending. Worthy, as they call him all up and down Canada, was his country's bug on mechanized equipment, one of those prophets without honor which every country seems to have. The United States had Billy Mitchell, France had De Gaulle, and quite possibly in Germany today there is some ignored seer telling Hitler why he is going to lose the war.

When the first World War broke out,

Scottish-born Worthington was a young adventurer in Central America—ship's engineer, mining engineer, and machine-gunner. Fresh from fighting against Villa for Madero, he went up to Canada and enlisted in the Black Watch. In France he was four times decorated for deeds which he will now describe only as "self-preservation." He wound up the war as a captain in one of the world's pioneer armored-car outfits, known as Brutinel's Brigade.

Gen, Raymond Brutinel was a French engineer, living in Canada, who early in the last war foresaw the coming of armored, mechanized warfare. His idea was so outlandish that his outfit had to be equipped by private subscription, with guns obtained in various ways, sometimes illegal. Its original equipment was a two-cylinder Autocar truck, with a steel box built around it, mount-

ing two Colt machine guns. When the masses of British tanks broke through the line on August 8, 1918, which Ludendorff called Germany's blackest day, Brutinel's Brigade came close behind, with machine guns on trucks, motorcycle side cars and trucks.

The battle plan for that day followed precisely the tactics used last June by the German armored divisions in France. Brutinel's column was to have dashed through and grabbed Roye, a rail center. But the battle that was visualized never quite came off, because the higher command was worried about protecting the flanks.

"But that was a tank battle, identical with what the Hun has done now," Colonel Worthington recalls today. "We showed the bugger the way. It boils me up. It's almost a shame he didn't have more tanks then, so we'd have remembered."

Vanks. When Canada after the war became even more demilitarized than the United States, he stayed on with the skeleton army, waiting for the war he knew was coming. Worthy was a very popular fellow, but was always talking tanks and mechanized warfare. Kind of eccentric on the subject. Or so people thought.

Four years ago the Canadian Army established a "tank achool" with Worthington in command. In the spring of 1938 he set up, in a few shacks in the deserted sands of Camp Borden, the Canadian Armoured Fighting Vehicles Training Centre, C.A.S.F. With the beginning of the war, groups of officers and men from tank regiments of the active militia were rushed in for training in tactics, radio, gunnery, and driving and maintenance, so they could go back to their own outfits and pass on the knowledge.



A World War tank shows its mettle on rough terroin

Even so, lack of equipment made it necessary to do much training with gadgets substituting for the real thing. Most ingenious of these is a device called a "rypa," a turret which joits and pitches like the jouncing of a tank, from which the gunner shoots airrifle pellets down a sand-pit range.

The lowlands blitzkrieg of last May suddenly brought to Canada the realization that it had done hardly anything about tank warfare. Tank building got under way almost immediately, in the Canadian Pacific Railway shops. Nothing is being said about when the new tanks will be delivered, or what they will be like. But a contract was recently let for nine carloads of pins for caterpiller tracks.

Well, I went up to Camp Borden to find out what in the world a nation at war wanted with those old World War clunks, and this story is what I found out. It is a Canadian story, but in many ways it might be a story of the United States, too. Our armored vehicles are also on order, and in army maneuvers we use ice trucks. But then again we have our own cat-skinners, and our lads from the mechanized farms, and the boys fixing their flivvers in the back yards—millions more of them than Canada. A lot of them will be getting together in barracks this winter, eager for machinery to work with. And it begins to look as though, in due course, they will be getting it.

At any rate, once the present excitement about production is over, we are going to realize strongly that there is a lot more in preparedness than machine tools. We're going to realize that the used-car lot and the despised jallopy are among the strongest links in our national defense. You can learn a lot from an old piece of machinery.

Mottled plumage of this pigeon would hide it from gunners



Capt. Ray Delhauer with a portable loft designed for field use. He breeds birds from strains that served in the first World War

Pigeons Are Bred with Camouflage for War Service

Camourlaged pigeons, with a mottled plumage to make them almost invisible to an enemy's waiting gunners, have been developed for emergency Army communication by Capt. Ray R. Delhauer, a retired United States Army pigeon expert, at Ontario, Calif. Most of his flock of several hundred birds are descendants of the harder strains of pigeons used by the Ailies and Germans in the last war.

Believing that the World War pigeons were too vulnerable because bright patches of white or colored feathers made them an easy target, Captain Delhauer bred and crossbred his birds until he achieved a strain with mottled gray and dusty white feathers on their underbodies as well as on their wings and backs.

The Army has today only 1,100 pigeons of its own for emergency communication, but Captain Delhauer believes there is just as much need for them as there was in the past, So that birds can be launched from warplanes without being thrust suddenly into a 300-mile-an-hour slipstream, he has built small metal cages with parachutes. Timing mechanisms open the cages and release the pigeons before the cages reach the ground. He has devised also a small metal message capsule, extremely light in weight, which can be inserted into a bird's crop and subsequently removed by gentle massage after the pigeon has reached its destination.

Two specimens of camouflaged progeons, By cross-breeding, It is possible to produce many plumage combinations



PLASTICS IN THE WAR





Splints of synthetic resin help surgeone care for wounded. In grafting skin and flesh, transparent coverings like that demonstrated on the lower mask allow the healing to be watched

By EDWIN TEALE

LASTICS go to war! That's the word from the armies of the

world, which are making soldiers of all work of the synthetic resins that were only laboratory babies at the time of World War I.

Today this substitute is being hurried into use in a thousand ways for two important reasons. It saves the steel and the brass and the wood so vitally needed for the building of tanks and guns and ships. And it lends itself to mass production in which unskilled labor can turn out many articles of plastic in a tenth the time it would take a skilled workman to make duplicates from the old materials.

London's women donned "bombing bonnets" created from cloth treated with plastics. Munitions workers and members of the Home Guard in England wore similar helmets, made of cloth impregnated with the synthetic resin and reënforced with wire mesh. Both types are almost as effective against falling objects as the conventional "tin hats" of the front-line trenches.

That's only the beginning of the wonders that are being wrought, for plastics are being tried for everything from surgical splints and gunstocks to leakproof fuel tanks and airplane parts. And ahead lies the dream that some day



Cutting an arm splint from plastic softened by heating.

soon whole sirplanes, save for the motors, will be stamped out as fast as tin cans are made now.

The peculiar properties of plastics are a major factor in their widespread adoption. A few weeks ago, for example, the United States Government ordered 2,000 army stretchers and specified that the handles should be of Tenite. This material is not affected by the poison gases of the battlefield, which corrode metal handles, or by weathering, which splits handles made of wood.

Another asset is the relative immunity of the synthetic resins to vibration. Thus they are replacing the time-honored brass cases on battleship instruments. Brass is stronger, of course, but it is much more likely to crack under the terrific vibration induced by gunfire.

In the medical field, lightweight plastic splints for use in emergency hos-

pitals have three distinct advantages. They weigh only a fraction as much as the common wooden splints. They are transparent, permitting a surgeon to examine the condition of the bandages beneath. And they of-



Gunners on big bombers crouch behind windows of transparent plastic

fer almost no obstacle to X-raying the broken bones at any time during the process of healing. At the Du Pont Experimental Laboratory in Arlington, N. J., such splints have been made of Lucite. They can be





Bent to fit comfortably, it is taped in place. Such a splint is lighter than one made of wood



shaped by the physician to fit the various individual needs of his patients.

A variation of the idea is a synthetic-resin window for plaster casts. In setting a compound fracture, the surgeon places the transparent piece of plastic in the cast when it is made. Through this window, he can then examine the progress of the healing at any time without removal of the cast. Similarly, transparent splints permit a surgeon to be sure a broken nose is healing properly, thus reducing the danger of a patient having a crooked nose as the result of his injury.

One of the outstanding exhibits at the recent Modern Plastics Competition, in New York City, illustrated a new technique in rebuilding human faces disfigured by accidents or wartime injuries. Developed by Dr. Charles M. MacKenzie, of Spokane, Wash., the new method uses transparent splints to keep close watch on the progress of the work during the grafting of flesh and skin. Two other advances of value to the Medical Corps are a plastic spotlight for use in the operating room, and a lightweight anesthetic table equipped with syntheticresin top and fittings. In England, a recently reported development is Bakelite coffins which can be turned out in mass pro-



Laminated-plastic construction provides light, strong control surfaces for war planes. On oxygen breathing bogs used in high-altitude training, nosepieces of synthetic resins are cool and will not irritate the skin as other materials do

duction and weigh only seventy pounds. For a number of years, American ex-

perimenters have been trying out, with varying success, gunstocks made of plastics. Recently a shotgun equipped with such a stock was placed on the market by a New England arms company. Both cheaper and easier to produce than the conventional walnut stock, it offers at-

tractive possibilities for mass production in army rifles. According to a report from abroad, some of the guns now being used by German soldiers are equipped with plastic stocks.

In aerial warfare, the initial use of plastics came in 1918 when Bakelite distributor cases were put on the famous Liberty engines of American manufacture. From that small beginning, the use of plastics in fighting planes has spread rapidly. Today, more than 120 different parts, ranging from moided instrument panels and lightweight doors for bomb bays to de-icing devices for radio aerials, aid in protecting the lives of the crews and in increasing the efficiency of the machines. Pilots sit on plastic seats, look out through plastic windows, control their engines by means of plastic throttles, consult instruments in plastic housings. The labyrinth of electric wiring which forms the nervous system of a big bomber is insulated with the help of plastics. At night, dials on the instrument panels are lighted by glowing rings of plastic material which require only the feeble gleam of a "grain of wheat" electric lamp to light them.

When the hu; a bombers of the Royal Air Force head across (Continued on page 225)

Tests Reveal Compatibility for Marriage

CHECKING up on the compatibility of persons about to be married is a predicted use for a system for measuring human relations developed by Dr. Ernest Chapple, of the Harvard University department of anthropology Dr. Chapple places the couple to be "personality tested" behind a screen through which he can watch them without being seen. While they chat, he records their reactions on a paper tape with a special machine. The instrument could also be used for studying personality problems of individuals.

Machine Gives "Tailor-Made" Pressing Job

SHAPING and pressing an evening gown, jacket, or house dress is just a single operation with a complex mechanism of roda, apringa, and gears invented in his spare moments by W. R. Frentzel, a Seattle, Wash., insurance salesman. Frentzel calls his machine "Symetra" because it eliminates possible wrinkles caused by pressing a garment on a flat surface like an ironing board. Measurements of the owner of a garment, sent with a dress to a tailor shop equipped with such a machine, would permit the tailor to meet exactly the requirements of the owner. The dress could be returned as form fitting, medium, or loose, as the owner wished. It would greatly simplify the correct shaping of knitted garments.



Will this couple "get along"? Watching through a screen, the scientist records their reactions on a machine which reveals their compatibility



Measurements are sent to the tailor with the dress. The dummy shown, adjusted to the measurements, then presses the dress to fit

"SWEAT + BRAINS + TRAINING"

Back-to-skill schools fit men for defense jobs

By BERT ANDREWS

MERICA is on its way back to the proud position it held so long—the reputation of being the greatest mechanical nation on earth!

It's getting there fast by adopting a formula that has never falled, and by hammering it home to the youth of the nation in its schools and its shops from coast to coast.

What's the formula? If you reduce it to words, it reads this way: sweat plus brains plus training. With one more important

double-plus—a place to get that training and an incentive to undergo it.

It's that double-plus that is being provided now on an unprecedented scale, thanks to three very excellent reasons. One is a \$15,000,000 appropriation by Congress to pay for the education and reeducation of men in the skills so vitally necessary to speed national-defense production. Another is the awakening of states and cities to the fact that they can help themselves by helping their citizen, off the atreets into jobs. The third is the alerthesa of private enterprise to the gospel of the day: "Don't weep over the shortage of craftsmen. Take raw



Skilled men are needed to assemble these plane-motor cylinders. A \$15,000,000 Government training plan

hands in and teach them, then you'll have the men you want."

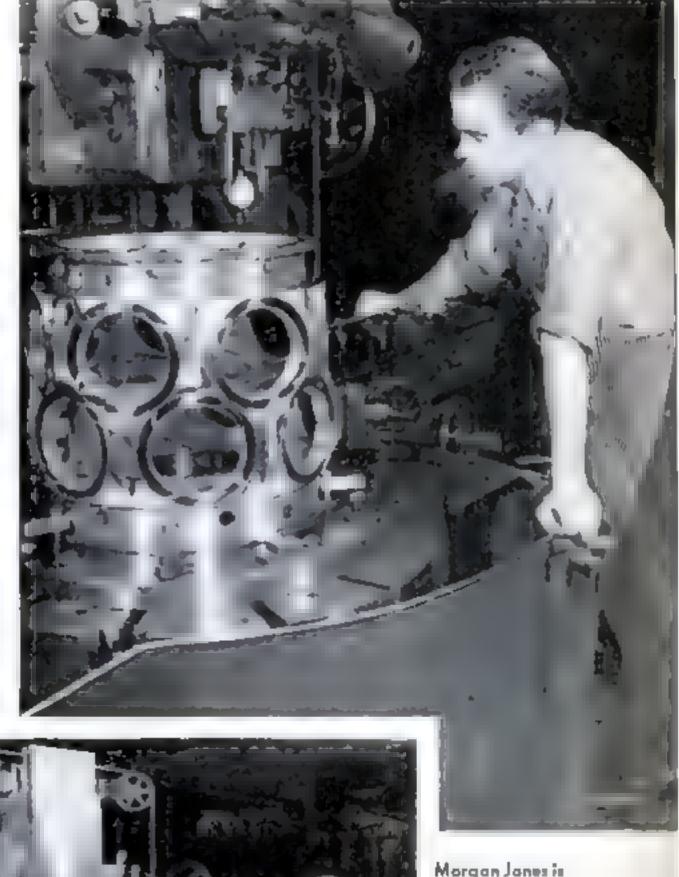
Chances are that you can see some phase of this inspiring back-to-the-skills movement in your community. Certainly, the evidences of it are plain if you dwell near the great aircraft plants, from United Aircraft and Wright Aeronautical in the East, to Consolidated in the West. Or near the

steel mills and the automobile plants and the electricalsupply factories that serve this nation of yours

As an object lesson of what a going on about you, consider a typical state, a couple of typical private companies and two typical youngsters who have lost their silly reverence for white-collar jobs and who now understand that Grandpa was right when he said: "What if you do get your hands greasy

in a shop? You learn. And what you learn stays with you."

There's the Connecticut Plan for Job Training. It came into being because a man got mad. That man was Carl A. Gray, Dartmouth '23, a tall, lean, grayish thinker who is president of the Grenby Manufacturing Company of New Britain. One day, on a train, he heard an Oregonian complain





a product of the new "back-tothe-sk lls"movement. Under the
watchful eyes of
veteran warkers, he learned
how to run a
Bullard vertical
turret lathe for
Prott & Whitney

is helping to provide them

about a \$150,000 W P.A. fly-casting pool near Portland. "Why," said the grumbler, "it won't even hold water."

The thought of the wasted money angered Gray. He knew that back home in Connecticut the machine-tool industries had been short-handed all during the depression, while thousands of young men were jobless.

And he asked himself questions. Why couldn't government and business get together to train men for jobs that were waiting? Why not make a survey of jobs and jobless? Why not try to fit the two together?

He put the questions to Governor Raymond E. Baldwin. "Go to it," said the Governor, and he forthwith made Gray the unsalaried head of a fact-finding commission. Most such commissions get out fancy reports and stop there. Not this one!

Plants. He got the use of school buildings by convincing school boards it would reduce taxes to have young men working instead of loafing. He argued some industries into letting their shops and machinery be used at night. He persuaded other factories to lend costly tools and equipment to supplement those bought by the State. And he broadcast the word: "Come and study yourselves into jobs."

There was only one restriction. The students must live in the communities involved; obviously, the gates could not be thrown open to nonresidents, since local residents were footing the bill.

Most of the students are between twenty-five and thirty. Some are younger and some—those being retrained in lost or forgotten skills—are older. The cost? Only seventeen dollars a student. The results? Well, for one thing they eliminated in these schools men congenitally unable to handle tools. That will be reflected in future accident rates, for such men eventually would have crippled themselves or their machines.

But the benefits go much farther. Five thousand were graduated in the first twenty-five weeks. Practically 100 percent were placed. That means 5,000 removed as potential relief clients. Pratt & Whitney division of United Aircraft, at East Hartford, takes the graduates as they are or accepts them for its advanced school. Hartford Machine Screw Company grabs all it can get and asks for more. So do Colt's Patent Fire Arms Company and many others.

That's what one state has done. Study now what Pratt & Whitney is doing in cooperation with the Connecticut plan and what Wright Aeronautical is accomplishing in Paterson, N. J., and Cincinnati, Ohio.

Pratt & Whitney established in August

an advanced course for boys who had completed the basic course. They furnished building and machines and instructors, who were paid by the state. They put in lathes and drills costing from \$1,000 to \$12,000, knowing that they would be treated with a craftsman's respect.

The students select their machines on the first day. They follow through on the same machines when they graduate into jobs. They do paper work, too, including mathematics geared to high-school graduates; blueprint reading and drawing, and descriptive material related to the specific machine and what it produces. And the successful ones start getting pay checks of fifty-five cents an hour for a 52-hour week, with a bonus that sometimes doubles that. Why? Because they can do low-tolerance work—extremely delicate work in which parts must fit to a few ten-thousandths of an inch.

The Wright company in Paterson is getting places, too. The number of their workers has jumped from 4,500 to 13,500 with the defense program. They advertised for skilled men. Couldn't get enough. They went to the Board of Education. Soon a vocational school was opened with a four-weeks course and 3,500 applicants, with residence in the vicinity a "must." In six months 582 were graduated and hired, including 155 on engine lathes, seventy-four on gear cutting, 107 on grinding, 106 on screw machines.

A student who graduates on Friday goes to work on Monday morning. He begins under a skilled machine operator and in a few days is turned loose on a machine of his own. There's no limit to how high he can climb. He may become a lead man, with many machines under his direction; a foreman in charge of a department, or, if outstanding, a production engineer

Wright's interests extend to Cincinnati, where they'll need 12,000 men to man their new plant, all to be hired from that area. They're thanking their stars that Cincinnati's big machine-tool and metal-working industries already have a four-year plan in operation to supply men who "know how."

THE Republic Aviation Corporation at Farmingdale, L. I., is training 8,000 new aircraft workmen at its own expense in a near-by aircraft school. The training fees will be paid by the company, and jobs are guaranteed to those who pass their tests. The students, however, must be residents of Nassau and Suffolk Counties, on Long Island.

But let's go back to Connecticut for some of the typical products of America's revival of craftsmanship.

Meet Morgan Jones, a short, compact, light-haired man of twenty-five, who was

graduated in 1940 from Yale. He was told there weren't any white-collar jobs in aircraft for him. "Who said I wanted one?" he asked. He got a room at the Y.M.C.A. in Hartford. He completed the basic program, He went on to the advanced Pratt & Whitney course. He's now in the company's shop, And the foreman fairly beams at him as he shows his skill on a three-spindle sensitive drill, a Bullard vertical turret lathe, boring center liners on a crankcase section for a twin-row engine.

Jones is one of the five percent who are college graduates. One who isn't is Marcel Lacasse, who attended a Catholic preparatory school. He raced through the advanced Echool in only eighty-four and a half hours, compared with the usual 150 or 200. Now he has a job doing the work he was trained for: miscellaneous boring, facing, rough and finished turning, centering, drilling, and undercutting.

And it's such boys as these that know the answer to one question so often asked: why don't the industries simply train apprentices in their own shops? The answer is, it's not always practical, particularly under the pressure needed in turning out planes and guns and tanks.

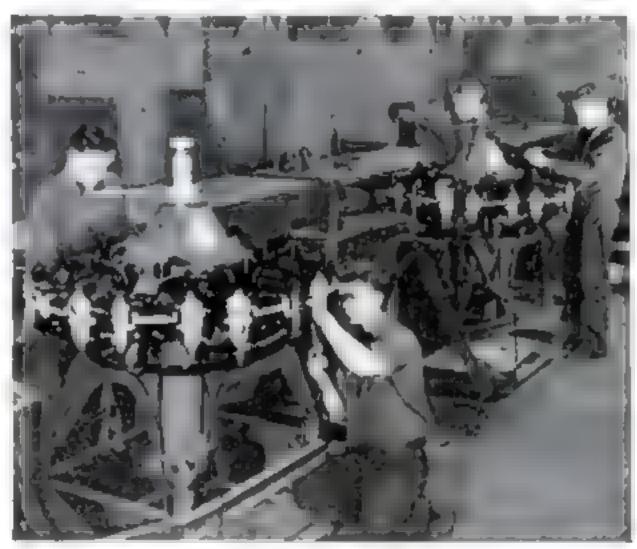
They know the answer to another question: won't too many men be turned out as mechanics?

Well, look at the figures:

The American Society
of Tool Engineers estimates an immediate
need for 32,570 tool engineers and 127,500
tool and die makers, to say nothing of the
semiskilled men who must at least know
their way around machinery. And A. F.
Hinrichs, Acting Commissioner of Labor
Statistics, estimates that 1,456,285 man
years of work will be required on naval ves-



An old-timer gives a tool-and-die recruit pointers on operating a planer. Defense work has created 160,070 new jobs for tool-and-die experts



Plane motors on the assembly line at the Wright plant in Paterson, N. J. A local vocational school helped supply a 200-percent payroll increase

sels and aircraft for defense during the fiscal year that will end next June.

That's why the country needs craftsmen. That's why the training program is booming. That's why America's on its way back to the heights. And that's why a horde of men are whistling at their work in a thousand machine shops today.



Electric Ears Hear Secrets in the Earth

URIED treasure and un-D dergroundpipe leaks are located easily by modern prospectors equipped with electrical detectors invented by Gerhard R. Fisher, of Palo Alto, Calif. The leak finder utilizes a sensitive crystal microphone and amplifying tubes to magnify sound 10,000 times. Carried along the surface of the ground above a buried pipe line, it picks up the faint sound of escaping liquid or gas. For finding buried metal objects, the other device emits radio waves which set up an electric field around any metal that is a good conductor. This causes a strong buzz in the earphones of the operator when the instrument is directly above the mass of metal. It has been used for locating floodburied tractors and trucks, recovering lost coins, and finding hidden veins of galena. Another use is in prospecting for pipe lines under the ground.

A sewer official hunting leaks with an instrument that magnifies sound 10,000 times. He is wearing a suit of rubber and a gas mask

Buried in mud by flood waters, this automobile was unearthed with the aid of an electrical "divining rod" which detects masses of metal





Professional actors dramatize a famous scene of history or literature in the studio for recording

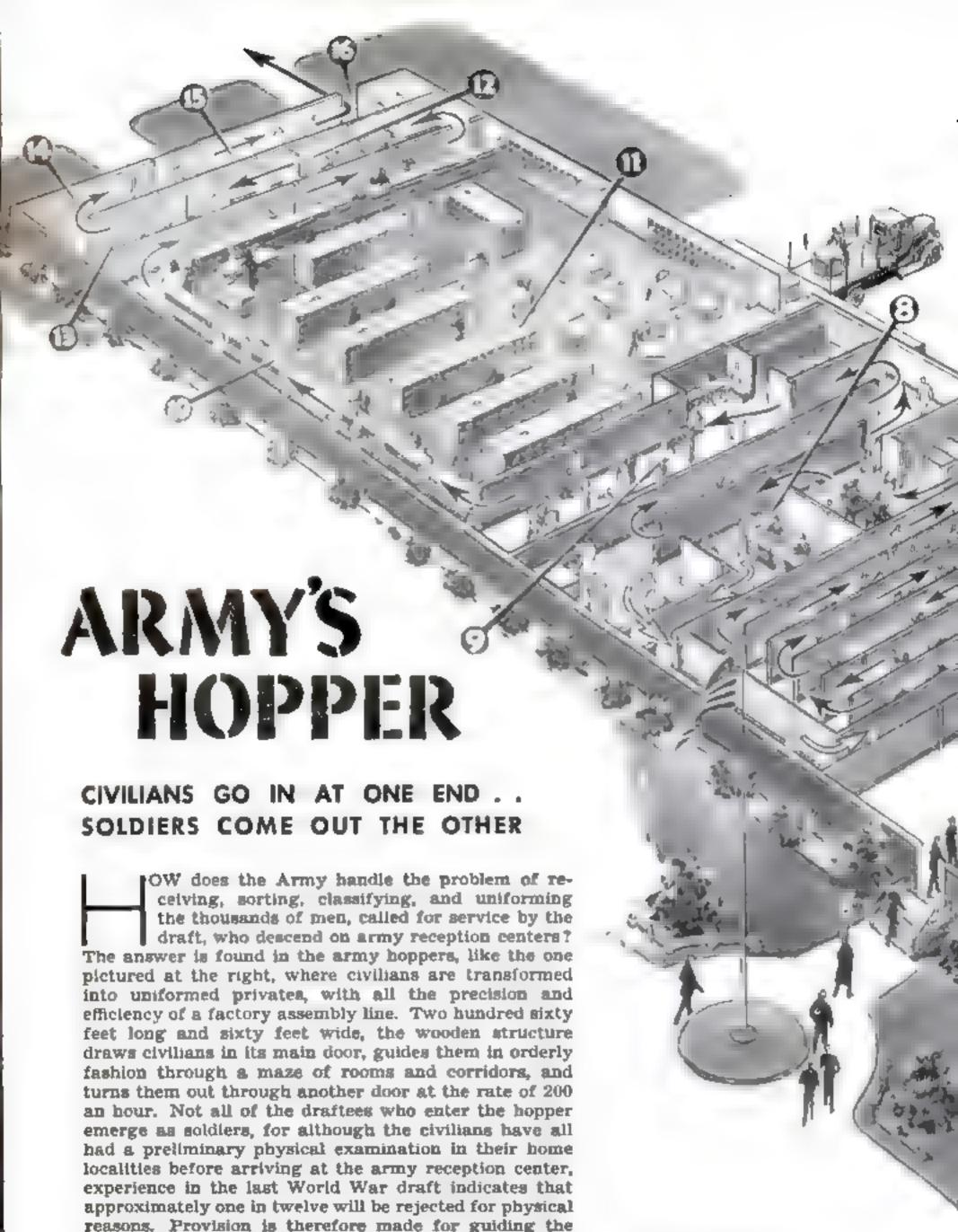
Records Now Bring History to Life for Students

AMOUS episodes in history and literature—stories that make people say, "Oh, how I wish I could have been there!"—have been re-created on phonograph records for American school children to hear and study. Teachers report that they make studies more exciting and real. The hoofbeats of Paul Revere's horse, Patrick Henry's ringing defiance, Long John Silver's bellowings, Scrooge and Tiny Tim, Portia's impassioned plea—these and many more have been recorded. Mark Hawley, radio commentator, has directed the dramatizations, with the aid of professional performers and writers.



In the classroom, school children hear an episode lifted out of the dry textbooks into vivid reality

JANUARY, 1941



Plan of the building at an army reception center where 200 drafters an hour can be transformed into soldiers. Follow and of them through the labyrinth

nine corps areas of the Army.

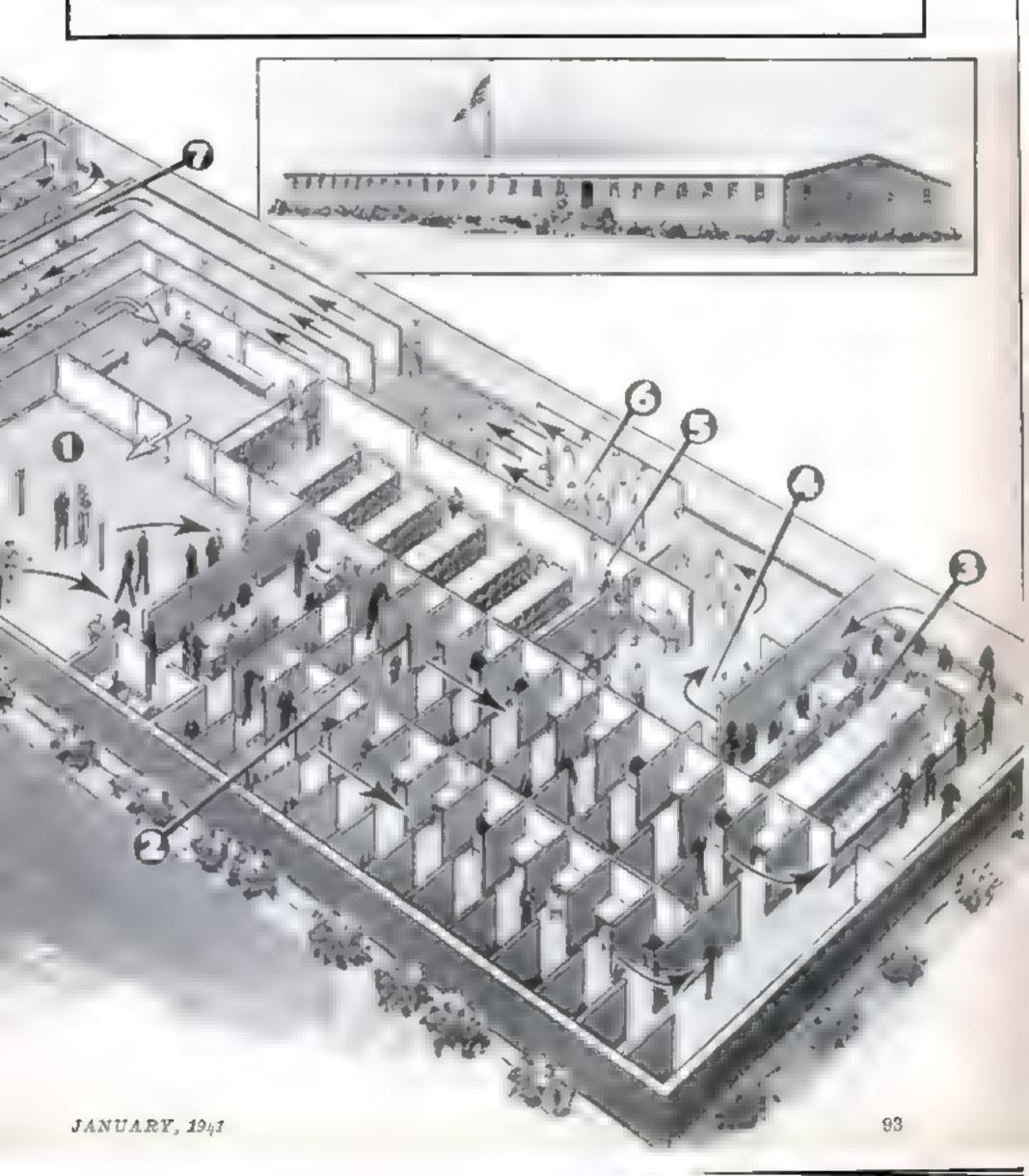
rejected men back through the same door they entered,

without confusing or interrupting the steady flow of

men through the complete hopper process. There is at

least one hopper at the reception center for each of the

As civilians, the draftees enter the main door of the hopper into a reception hall (1) where they turn right into a reception office (2). Here they fill out questionnaires giving personal date and proceed to the next room where they are fingerprinted (3). This done, they take off their clothes (4) and hand them through a window into a check room (5). Now naked, the draftees walk through hat showers (6) and continue down carridors [7] where physicians give them physical examinations and turn doubtful cases over to medical boards of review (8). Rejects are shunted back to the check room (5) (follow white arrows) to don their civilian clothes and go home. The others proceed to a fitting room (9) where they are measured for uniforms, which they draw at the counter (10) of the supply room (11). The men move on to a dressing room (12), and when in uniform take a psychological aptitude test (13) before they are assigned to companies (14) and take the soldier's each (15). They emerge at the side door (16) as uniformed soldiers in the U.S. Army.



A .50 coliber machine gun can be put on any truck with this mount

Antiaircraft Gun Mounted on Truck

MADE from a steel plate four feet square, plus materials picked up in a junk yard, a new machine-gun mount developed by soldiers of the 65th Coast Artillery antiaircraft regiment makes it possible to install a .50 caliber machine gun on any type of commercial truck. Costing only \$9 80, the mount would make it possible to outfit commandeered trucks of every type for emergency defense. Regular .50 caliber mounts can only be employed in firing from the ground,

Microscope Stand Holds Sixty Mineral Specimens

Sixty mineral specimens are accommodated at once on a turntable which forms part of a universal microscope stand devised for amateurs by Jay T. Fox of Seaford, N. Y. Any specimen can be brought under the lens by turning the table. For studying single specimens, the turntable is replaced by a ball-and-socket arrangement which allows the mineral to be tilted at any angle desired. The mount also supports the binocular microscope and various accessories.





Joy T. For studying minerals with his composite microscope stand, also shown at the left. Specimens are mounted in tiny boxes on the turntable



R. WILLIAM R. HAINSWORTH, vicepresident in charge of engineering and research of Servel, Inc., climbs bitherto unclimbed mountains for relaxation and devotes to his hobby the same concentration of effort which has made him one of the refrigeration industry's leading engineers. In both fields, he says, scientific preparation is the key to success.

"Whether it's a mountain or research," says Dr. Hainsworth, "you're looking for a

Untrodden heights have an irresistible ailure for him. For twenty years he has been extending scientific frontiers by laboratory research and in the last twelve years he has scaled twenty-two mountains which never had been climbed before. In 1933 the American Gas Association awarded him the Charles A. Minnroe medal for "the most outstanding contribution by an individual to the advancement of the gas industry," but whether Dr. Hamsworth was more elated by that recognition of the air-cooled gas refrigerator or by his successful ascent in 1938 of 12,972-foot Mount Robson, tallest peak of the Canadian Rockies, is hard to say.

Dr. Hainsworth's special delight is a mountain which has not been climbed. The spirit of the venture is the same which made him a leader in the development of the gas-operated absorption refrigerator from the water-cooling system of early days into the modern, air-cooled refrigerator.

He studies American and Canadian alpine



A peak of the Canadian Rockies snapped from a high elevation



Hans Fuhrer and Howard Corlson show trout against Mt. Robson



Dr. Hainsworth working slowly up an ice field with a full pack

journals and, selecting his field, reads all the information available and makes a study of the geologic formation. He collects all the photographs he can find of the region and studies them with the aid of maps, marking spots which look dangerous. Sometimes he has airplane photos made.

In his attack upon an unscaled peak, Dr. Hainsworth relies upon the knowledge and experience of his companions and his own judgment. Before starting his climb, he mounts adjacent ridges and peaks and checks with field glasses the maps, pictures, and notes he has brought with him. He examines his chosen mountain from various sides to be certain that he will select the most practicable route.

Generally his plan of campaign meets with success. but sometimes unexpected and unpreventable circumstances thwart him. made his first attempt on Mount Robson in 1930, the same year in which he climbed Mount Carlton and Mount Warren overlooking Maligne Lake, near Jasper, Alberta. A succession of severe snowstorms compelled him to retire. He tried Mount Robson again in 1934 and again was driven back.

In 1932 he reached the top of Mount Oubliette, near the headwaters of the Fraser River in Alberta. Its altitude is only 10,100 feet, but its ateep and dangerous slopes had baffled some of the best climbers in America. Dr. Hainsworth made his only European trip in 1936 and climbed the Matterborn to keep in practice,

It was in his successful attempt on Mount Robson in 1938 that he had his narrowest escape from disaster. He was making his final survey of the alopes the evening before starting his climb, when a great chunk of Mount Robson's ice cap fell and started an ava-

lanche. The slide was three miles long and spread to a width of half a mile. It wiped out the spot which Dr. Hainsworth had just selected for his next camp.

"If the avalanche had come twelve hours later—good night!" was Dr. Hainsworth's comment. He worked out a new route with a new camp site and completed the climb in four days.

Of course, it takes something more than a scientific mind to make a successful mountain climber and Dr. Hainsworth has those attributes too. He was fullback on the football team of the University of Washington and still has a fullback's physique, It was in 1914, when he was eighteen years old, that he got his first taste of mountain climbing. He and another student got jobs as forest rangers during the summer vacation and were sent to take a census of deer, bear, and mountain lions in the Olympic National Forest.

"Whenever we saw a mountain that struck our fancy," says Dr. Hainsworth, "we'd take a few hours off from counting animals and climb it just for fun."

Then for some time Dr. Hainsworth was too busy for mountains. Years of postgraduate study brought him as research associate to Massachusetts Institute of Technology where he experimented in 1921 with the photo-electric transmission of photographs.

It was not until 1928, the year before he began his association with Servel, Inc., that he got around to mountain climbing again. He has several peaks on his list now and, for the last three years, he has been directing development of an all-season, gas-operated air conditioner to provide heat in cold weather and coolness in warm weather. That's another peak.



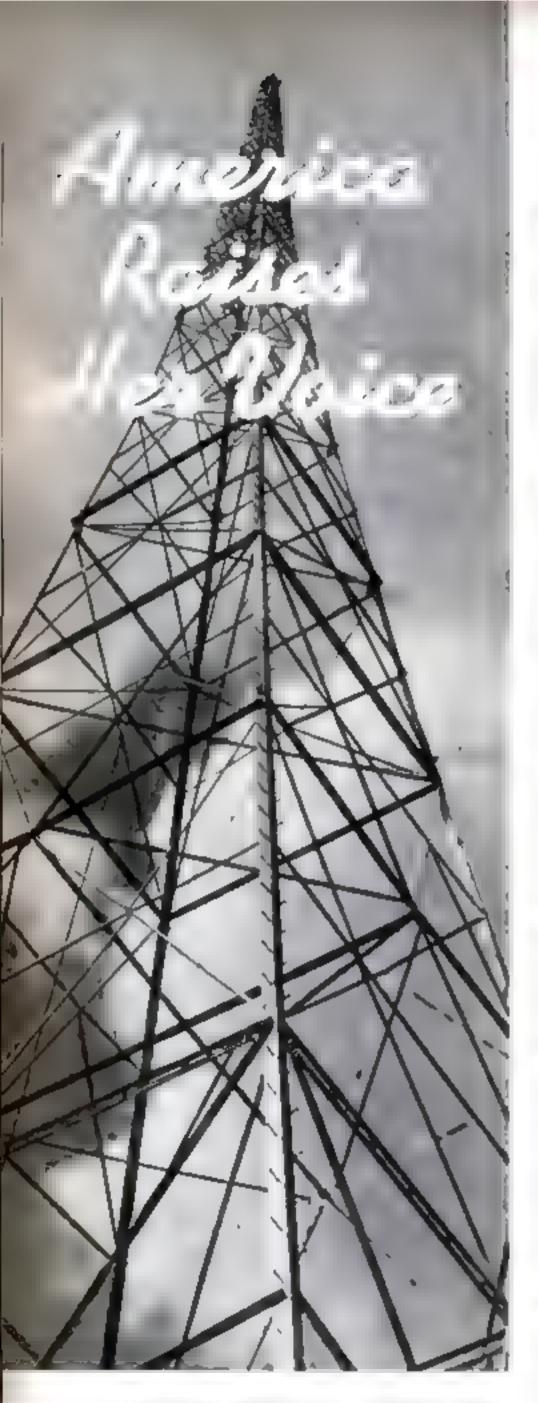
Members of the Hainsworth party exercising on snow fields . , .



... well below Mt. Robson, which they finally conquered in 1938



These photos are enlargements made from a 16-mm movie film



By ROBERT E. MARTIN

VAST expansion in its international short-wave radio stations is giving the United States a new ace to play in the never-ending game in which world powers seek to bolster their prestige over the air.

Two million dollars is being spent on new transmitters which will double and treble the power of many American stations. When the work is finished, in the spring, this nation will be able to compete, particularly in Latin America, on an even wattage with the huge short-wave stations of Europe, and thus will be able to attain three objectives: Correct false impressions about this country; provide uncensored news free of propaganda, and beguile listeners with entertainment.

No longer, then, will the smooth-voiced word dispensers of unfriendly lands be able to tell our neighbors, without getting a quick answer, that ours is a country made up exclusively of gangsters, goldfish-swallowing college boys, and materialistic busi-

There are 2,100,000 short-wave receiving sets in South America. This country's broadcasters believe that they are reaching most of them now, and will soon reach all of them, with the story of the United States as it really is.

The audience is willing: no doubt of that. For where the National Broadcasting Company received less than fifty letters a month from South America in 1936, it now gets 2,500 a month. And many of them emphasize they are disgusted with the propaganda fed them by European stations.

The great amplification of the transmitters in the United States was decided upon last summer at conferences between representatives of the State Department, the Federal Communications Commission, and officials of the twelve international broadcast stations, all privately operated.

Most of the stations will rise in power to 50,000 watts. Actually they will have much greater than 50,000-watt effectiveness in South America, for engineers have developed directional antennas that narrow the field of the broadcast to a long, fanshaped beam pointed over any part of the world desired. And inside that beam, a 50,000-watt station has the effectiveness of 500,000 watts.

Before the construction program was ordered there were only two stations here with 50,000 watts or better. One is the 50,000-watt station WLWO, of the Crosley Corporation, Mason, Ohio. The other is WGEO of the General Electric Company, South Schenectady, N. Y., which has a power of 100,000 watts but operates at 65,000.

The other international broadcast stations and their pre-construction power were WNBI and WRCA of N. B. C., both at Bound Brook, N. J., both 35,000 watts; WCBX, Columbia Broadcasting System, Wayne, N. J., 10,000; WCAB, WCAU Broadcasting Company, Newtown Square, Pa., 10,000; KGEI, General Electric Company, San Francisco, Calif., 20,000; WGEA, General Electric, South Schenectady, N. Y., 25,000; WBOS, Westinghouse Electric and Manufacturing Company, Millis, Mass., 10,000; WPIT, Westinghouse, Saxonburg, Pa., 40,000; and WRUL and WRUW, both of the World Wide Broadcasting Corporation, Scituate, Mass., both 20,000 watts.

They will need the added power and the directional antenna to meet the competition. In 1930 there were only three short-wave stations in all Europe. Now there are at least forty, with more being built all the time. Germany constructed eight such stations in 1936 to broadcast the Olympic games, and used these as a nucleus of a system which has been augmented with the capture of each new country.

Germany has heretofore had many advantages over American stations. The German radio is financed by government funds

so that the broadcasters have been able to use as many as six transmitters for one program, feeding it out over different wave bands so that listeners finding interference on one will be almost certain to get clear reception on another. In addition, the Germans have paid many South American stations to pick up and rebroadcast programs.

ITLER'S speeches are rebroadcast as many as six times by the German radio. The addresses of King George VI and Prime Minister Winston Churchill are repeated by the British almost as often by recordings.

All this repetition and predominance in numbers can be offset, broadcasters here believe, by the increased power of the American stations and by the directional antenna. Dr. E. F. W. Alexanderson, General Electric's radio wizard, originally designed such an antenna to assure reliable reception by Admiral Richard E. Byrd's expedition in Little America near the South Pole. Within the past year a steerable directional antenna has been developed by N. B. C. engineers and put into operation at WRCA.

Beams of the directional antennas have proved so strong at times that the signals have passed over to the other side of the



America creates good will via the radio. One of NBC's foreign-language announcers broadcasting uncensored news free at propaganda in a program directed at South America's 2,100,000 short-wave receivers



world. A listener in Melbourne, Australia, wrote NB.C. that when he accidentally tuned into the South American beam "I was surprised to find my receiver almost blown out of my hand by the volume of your signals." A priest doing missionary work inside the arctic circle north of Nome, Alaska, astonished N.B.C. men by writing that he had been enjoying the descriptions in Spanish of the fights in Madison Square Garden.

For several years America's stations have been devoting themselves to the patriotic service of sending out honest information to the countries in which foreign propaganda has been at work. They have broadcast operas, symphony orchestra concerts, and oral descriptions of cultural pursuits in this country, all intended to show us in a better and fairer light.

The news reports have been most popular. N.B.C. sends out fifteen minutes of last-minute news every hour on the hour for sixteen of the twenty-four, giving it alternately in Spanish, Portuguese, French, Italian, German, and English. In all, the American stations are short-waving thirteen hours and nineteen minutes of news a day to Central and South America.

American radio stations, by feats of unparalleled speed in reporting, have scooped the official German and British government radios on their own most important news, by margins of a half hour or more. English listeners heard from the American stations their first news of the invasion of Norway.

President Roosevelt's major speeches have been put on the air in Portuguese and Spanish within thirty-five minutes of the time he has delivered them. Swift, highly skilled translators have made it possible, N.B.C. has repeated the President's remarks as often as three times in Spanish and twice in Portuguese to be sure that all parts of South America, which stretches from east to west across six time belts, can hear it.

Besides the sober work of improving American international relations, the short-wave stations have their more informal moments. WGEO has a "mail bag" for Admiral Byrd's men on Friday nights, broadcasting messages from friends. Two-way conversations on the program across the 10,000 intervening miles have come through as clearly as local phone calls.

A stunt on one of these intimate programs provided General Electric with a highly valuable property, a distinctive signal which its stations now use as their signature on the air. Short-wave broadcasters throughout the world envy the British radio, which has the chimes of Big Ben, the famous clock of the Houses of Parliament, as its identifying signal.

American broadcasters have searched for

a sound that would symbolize the United States just as well. The only thing in Washington comparable to Big Ben is the Arlington Naval Observatory time signal, but the only noise that makes is a "beep-beep." The Liberty Bell is cracked and silent, so that is out. The noise of American steam engines was considered but rejected. One broadcaster summed it up cynically by saying that false ideas about the United States are so general that the only sound that would be recognized as the United States would be the wail of a police airen followed by the rattle of machine guns.

THEN General Electric hit on a signal which, at least for its stations, has solved the problem. Thunder and lightning storms are unknown in ice-covered Little America, so one night as a joke the engineers of General Electric broadcast to Byrd's men the crashings and bangs of 10,000,000 volts of artificial lightning created in the G. E. laboratories. "Here's something you are missing," the announcer told the men of the expedition.

The noise was most impressive. Soon afterwards, General Electric made a recording of the thunder of three man-made lightning bolts, and since then has used it as its signature on the air. The "voice of electricity" not only is appropriate for the company's stations, but also symbolizes the might of American scientific progress,



Translations of President Roosevelt's speeches are recorded and rebroadcast for different time zones





Want to be a gold miner for a day? Just follow this sign to the Seltzer Mine, where half a dollar will rent you the use of a "glory hale," a pan, and water

Dude Gold Mine

UNDREDS of amateur miners in southern California every month experience the thrill of digging out "glory holes" and panning their own gold. Not one goes home empty-handed. John Seitzer guarantees that all will find at least a trace of the precious metal.

For twenty years Seltzer worked a mine running across the mountains overlooking Haskell Canyon, which is only a stone's throw from Placerita, where gold was first discovered in California. Last year he broke his right arm in an automobile accident. Unable to work for several months, he opened his property to the public. Want ads in Los Angeles papers announced that for fifty cents a person, he would supply a glory hole, pan, water—and gold.

The novel idea caught the public's fancy. Families would spend the week-end up Haskell Canyon while Papa and the kids dug and panned. While no one has struck it rich, several have taken out enough gold to make a ring or other ornament. Seltzer shows prospectors where to

PANNING ORE

sa Seltzer rigged up this gasaline engine and pump to furnish it to his patrons

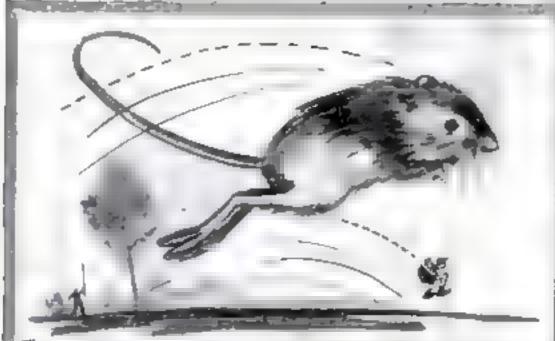


Amoteur prospectors look on while their host shows how it is done

dig, and gives expert instruction in panning.

He does not promise anyone wealth. Biggest day's take from ore running seven dollars a ton is two dollars. "When anybody
hits fifteen-dollar ore," he says, "I'll lock
the gate and begin mining again, myself."

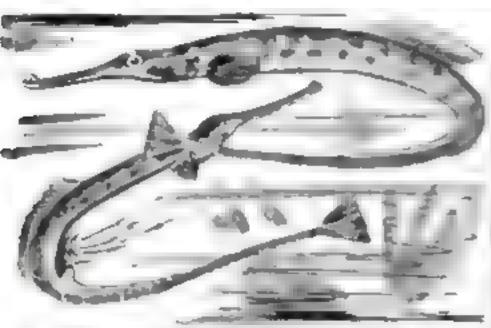
Un-Natural History Gus Mager



THOUGH ITS BODY IS ONLY ABOUT THREE INCHES LONG, THE JUMPING MOUSE CAN LEAP TEN FEET WHEN ALARMED! TO EQUALIT, A MAN WOULD HAVE TO JUMP 120 FEST! -



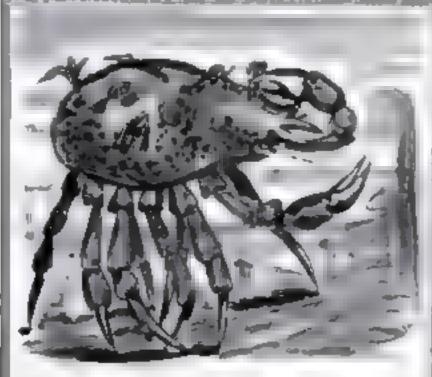
LEAVEG OF THE APE-APE PLANT ARE LARGE ENOUGH TO HIDE A MAN! THEY GREW ON ALL CONTINENTS IN PREHIGTORIC AGES BUT NOW ARE FOUND ONLY IN HAWAIL



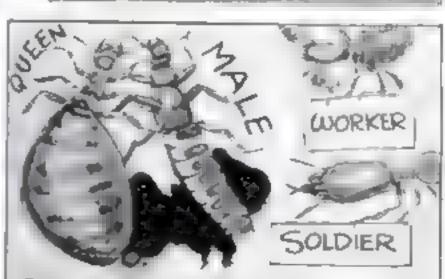
AN ASTOUNDING METHOD OF REPRODUCTION IS THAT OF THE PIPEFISH! THE FEMALE LAYS HER EGGS IN THE KANGAROO-LIKE POUCH OF THE MALE, WHERE THEY HATCH AND DEVELOP FROM EMBRYOS!



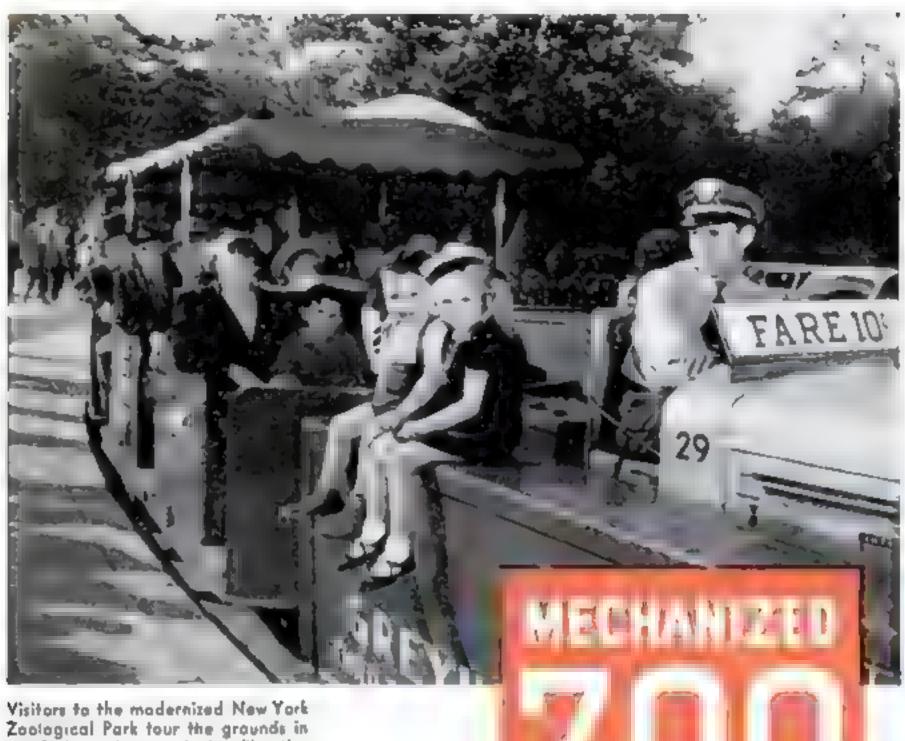
THE SOUTH AMBRICAN JACANA ESCAS TO WALK ON THE WATER' REALLY, IT USES ITS WALK SLENDER FEET TO WALK ON FLOATING VEGETATION .



ALWAYS ON ITS TOES IS THE LUDICIDUS SHEEP CRAB OF THE CALIFORNIA COAST A BORN TOE DANCER, IT DOES BALLET STEPS ACROSS THE KELP BEPS!



IN SOME SPECIES OF TERMITES, THE KING AND QUEEN STAY MATED FOR LIFE! ONE SUCH COUPLE, IN AN OBSERVATION NEST, CELE-BRATEDITS SILVER WEDDING ANNIVERSARY



comfort on tractor trains like this

By JOHN O'REILLY

WEEPING changes are being put into effect at the New York Zoological Park. Through the use of new ideas, some borrowed from other parks and others the product of home-grown invention, visitors soon will be able to take an actual part in the zoo's activities.

This spring, when the new program goes into full swing, visitors will find themselves actually stroiting out on an African plain populous with full-grown lions, antelopes, giraffes, and zebras. No barred cages will obstruct their view. Instead, broad moats, cunningly camouflaged, will separate the lions from the docile grass eaters and the spectators from the animals.

To create the illusion, four acres of the park's land had to be carefully laid out and landscaped. Upon entering the ornamental entrance to the group the visitor will pass through a hallway where photographs taken in Africa will be arranged in montage. As he inspects them, he hears the steady throb of the African signal drums, seeming to come from a great distance. It will really come from recordings through an amplifier.

After being put into a thoroughly African mood, the visitor comes out upon a walk. On his left is a low wall, and beyond it stretch the plains of Africa. Zebra, eland, water buck, bleabok, hartebeest, reedbuck, bush buck and ostriches wander beneath trees which are as much like the nat-topped trees of Africa as the zoo's experts have been able to grow in this climate.

Farther out on the "plains," lions roam at will. On the right is an African water hole where animals congregate to drink. All this seems to be in one area, for by a clever arrangement of ledges the separating moat is concealed.

The exhibit will be open from May to November. Winter quarters have been built near the group and some of the hardier creatures, such as lions, will be turned into

the plains on warm days during the winter. Although the largest single project undertaken so far, the African Plains is only one means adopted to bring the zoo closer to the

people.

Allyn R. Jennings, the general director, found that the park was using 4,000 pounds of butterfish a month, most of it going to the sea lions which occupy a big pool at the north end of the park. He sat down to figure out some method of helping to defray the cost of all this fish and at the same time provide more enjoyment for the public,

Now visitors at the sea-lion pool find an attendant with butterfish for sale at five cents each. If you want to feed the sea lions, you pay your nickel and the attendant hands you a acoop and puts a butterfish in it. Then

you pick out the sea lion you want to

feed.

Two of the sea lions prefer to stay on top of a big rock on the opposite side of the pool from the feeding stand. If the visitor can throw a fish fifty feet across the pool with such accuracy that one of these sea lions can catch it, he gets a free fish to throw.

The fish-throwing game proved so popular that after it had been in effect a week they had to get four more sea lions. The animals are fed no more than their regular ration, and when that has

been eaten the game stops.

Since the sea-lion feeding made such a hit with the public, it was decided to extend it to other animals where possible. Vending machines containing scientifically prepared food for mammals and mixed grains for birds were set up at various points in the park. Before, there had been a \$3 fine for feeding animale.

By inserting a nickel in a machine and turning a handle, the visitor receives a

Down come horsh "warning" signs, The public is made to feel at home





small cellophane bag of animal food. When visitors know that they can buy scientifically prepared animal food in the park, they are not so apt to feed chocolate candy, lipstick, rubber bands, and bottle caps.

Children like to ride animals as much as they like to feed them. To satisfy this desire, the park bought three baby elephants and designed bowdahs for them and a loading platform. They found that llamas, used as beasts of burden in South America, were excellent for pulling a cart full of children, and another llama was provided with a saddle. A tanbark track with two loops was constructed, and now the zoo's strange riding academy is a popular spot.

In the bird house, humming birds are exhibited in a large cage with a plate-glass panel. In it living plants were arranged and on their twigs were attached small bottles of honey and water for the tiny birds.

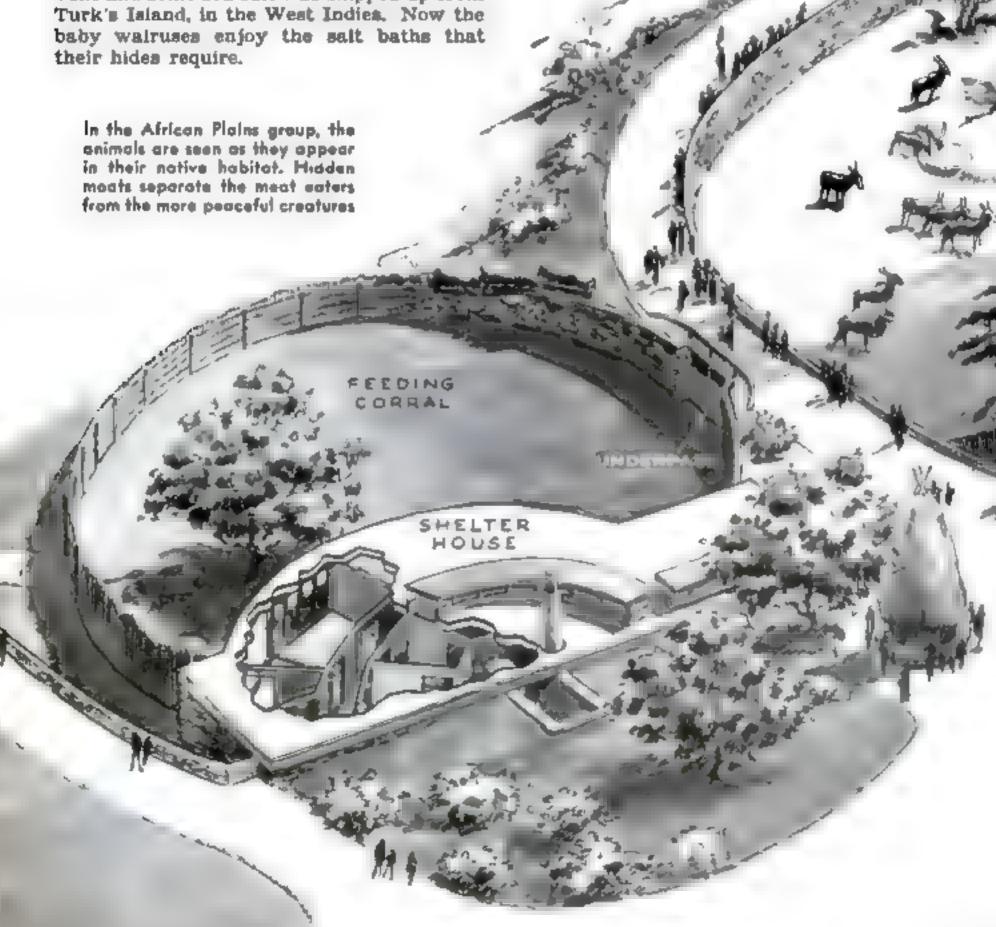
In the walrus pool, where there are four baby wairuses, a small wairus bathtub was built and some sea salt was shipped up from

fined, have been favorably received by the park's swarms of visitors. Fairfield Osborn, president of the New York Zoological Society, feels that these new steps are only the beginning of a broad program. "By using scientific principles," he said, "we are making the park a healthier place for our animals and we are giving the visitor a chance to feel that he is participating in what we are doing. As the public become more eager, they absorb more of the knowledge of animal life which we are interpreting. That, after all, is why we have zoologicai parks." Drawing by B. G. SEIELSTAD

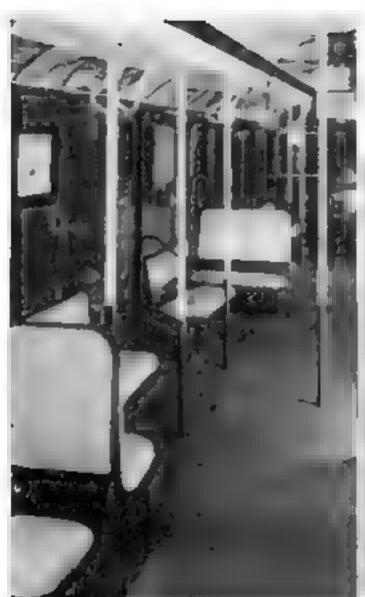
These and numerous other innovations.

including a careful use of colors in painting

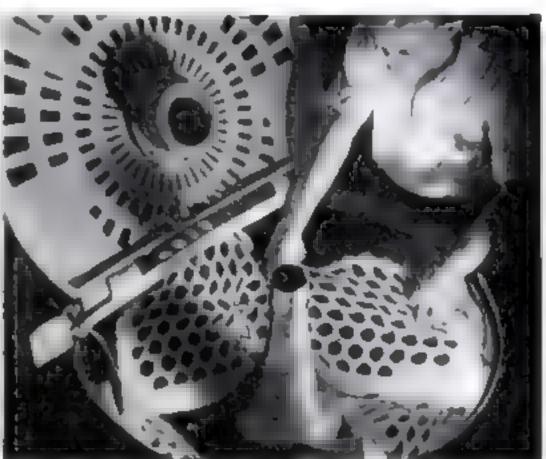
the cages of animals that have to be con-



AFFECTS CHEATE LAFFECTS CHEATE LAFFECTS ATMOSPHERE SPRING ESCAPE RAMP FALLING INTO MOAT BAMBOO-COVERED FENCE NO ARTIFICIAL BARRIERS TO K SPECTATORS VEW MOAT



Seats of Woven Plastic Tried Out on Subway



Subway car equipped with plastic seats. At right, cellular rubber cushions in a centrifugal drier

ESS damage to women's hosiery, longer wear, and ease of cleaning are advantages claimed for a plastic seat covering recently installed experimentally in cars of the New York City subway system. Marketed as Saran, the plastic is produced as a continuous strand and then woven into

material resembling natural rattan seat coverings. Saran doesn't split or crack, and thus there are no projecting pieces to snag clothing. Since it is nonporous and dirt cannot penetrate the surface, it can be cleaned with soap and water. It is used with cellular latex cushions.

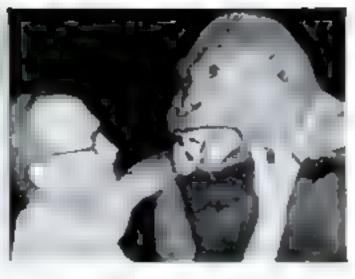
Home Power Saw Is Built from Kit

A POWER SAW suited for the home workshop, which can be built from a kit or purchased assembled, is now available. Two kits may be purchased, one containing only the metal parts, the other all parts ready to assemble. Plans alone also can be purchased. Designed to rip, cut off, miter, groove, dado, and perform other operations, the saw has a twenty-four by thirtyinch top and can be powered with a motor of from a fourth to one horsepower. Kits for the complete saw include a combination rip and cut-off saw, a ball-bearing arbor, miter gauge, ripping fence, and saw guard. The finished saw can easily be carried by one man.

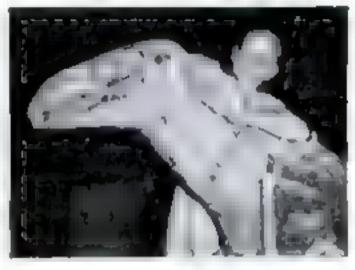


Ripping a two-by-four with a power saw built of kit materials





John M. Schleisser fitting the skin on a movie garilla. Hides of three black bears were used to cover the lifelike six-foot papier-miché body



Slabe of clay on a wire screen build up the neck of a mechanical pany that gallops realistically for close-ups

Movie Beasts Made to Order

big gorilla flash on the acreen at your favorite movie house, the chances are it's the work of John Michael Schleisser, noted Hollywood taxidermist. Working from measurements of living specimens, and sometimes from skeleton remains, Schleisser first models an animal in clay and from this turns out a papier-maché figure which is then covered with a hide of the particular animal—or, if that is not available, with a hide of some similar beast. The hides of three black

bears, for example, covered a gigantic gorilla he made recently. This animal figure, which weighs 200 pounds and stands nearly six feet tall, has head and hands of sponge rubber, which are moved by invisible wires



to give the beast animation. A pinto pony, complete from head to tail except for the feet, rides on a galloping mechanism. It is used for close-up shots in front of a screen on which moving scenery is projected.

Birth of a Bauble

N ITS first year of operation, the world's only mass-production factory for manufacturing glass Christmas-tree ornaments, the Wellsboro, Pa., plant of the Corning Glass Works, has turned out more than half of all the new decorations which will bedeck

American trees this season. At the rate of 400 a minute—approximately 2,000,000 a week—the brightly colored globes have been pouring from the production, line. Six months of intensive work by Corning engineers made possible the Ingenious machines

which turn a pound of gisas Into ! thirty average-size ornaments. A ribbon of molten glass enters one end of the production line and a steady stream of bulbs which have been shaped, silvered inside, and tinted outside, comes out at the other end. One hundred and eighty different sizes, styles, and colors are produced at the Wellsboro plant. Formerly, most of our glass Christmas-tree decorations came from central Europe, where families of craftsmen formed and tinted them by hand. Machine methods not only speed up production but are said to turn out more uniform globes.



This control room feeds air and gas to the tank furnace of the Weisboro, Pa, plant of the Corning Glass Works, where a mixture of sand, sada ash, and lime is turned into dainty bubbles of glass to adorn America's Christmas trees

2 Down a hopper into the furnace come the carefully mixed ingredients. It takes about three weeks to change a batch of the row material into usable glass, which is of almost the same lind as that used for electric-light bulbs





A mass-production bauble. The Corning plant makes 400 in a minute

3 From time to time to sample of glass is taken out of the furnace for testing. Just as an expert candy maker our tell when condy is ready to take from the stave, so a skilled glass worker can judge the quality of his glass by eye. The viscosity shows when the glass is ready for use

A New material is added little by little until about thirty-five tans of glass has been prepared. Guarded by steel shields from the 2 800-degree heat, a workman pushes the finally ground mixture anto the malten mass [CONTINUED]



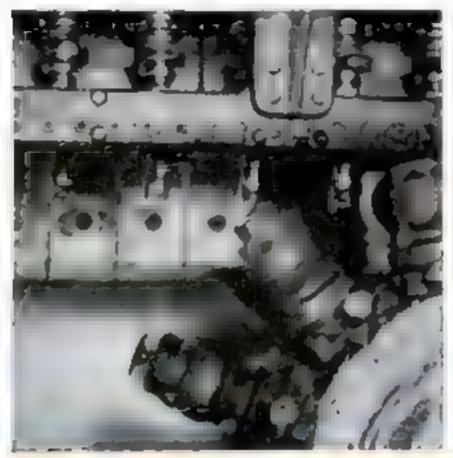
5 Shielding his eyes from the blinding glare of the flames with a window of dark glass, a workman peers through an opening in the furnace, whose heat reproduces in miniature the conditions on the sun

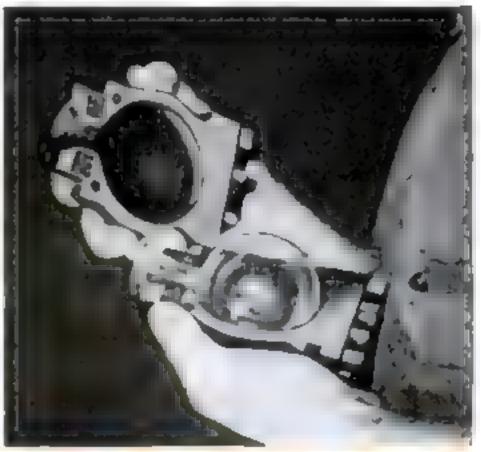
6 Streaming from the furnace, molten glass enters the "ribban machine," which carries it along between rollers like a moving ribban. This machine is also used in the manufacture of electric-light bulbs





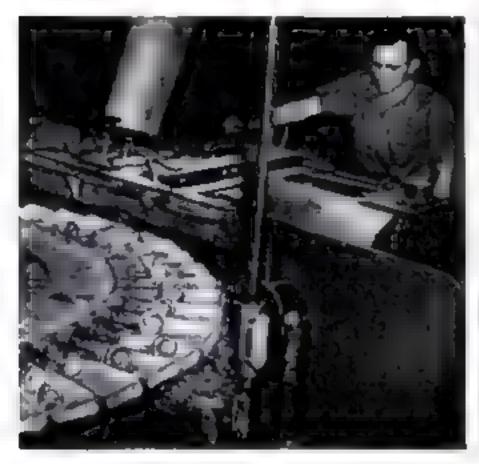
As the ribbon goes along horizontally, clinging to the underside of a moving belt, puffs of compressed air blaw through it from above to form bubbles that grow in size until each is plucked off between the halves of a mold moving up to meet it 8 Clamped inside the mold, the bubble of gloss is blown up to the desired shape. In the picture below, one of the molds has been opened to show how the glass sphere is formed with its neck attached. Molds are changed to make armoments of any type





Asbestos "hands" on this rotary transfer mechanism take the hot, shaped bulbs from the molds of the ribbon machine. Then, turning from a horizontal to a vertical position, they lay them on a belt . . .

10 ... which carries them to the "lehr" for coaling, it takes the globes about twenty minutes to pass through this forty-foot machine, where the temperature is lowered gradually to prevent strains.

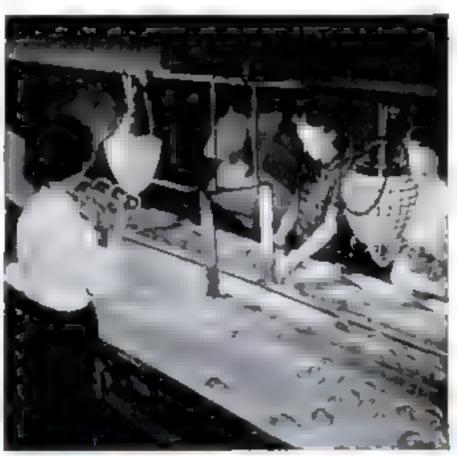




11 Emerging from the lehr, the bulbs are carried by a maving belt past girls who remove broken pieces. At this stage, the clear glass spheres resemble soap bubbles floating on a stream of water. A pound of glass makes thirty average-size globes

12 These girl Inspectors are examining the globes for imperfections. Modern machine methods used at the Corning plant not only permit greater speed of production, but also turn out stronger and much more uniform property. (CONTINUED)





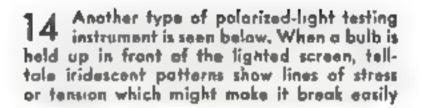




13 Picking up bulbs at random from the moving belt, this inspector holds them against the polariscope, in which polarised light reveals any strains created in cooling

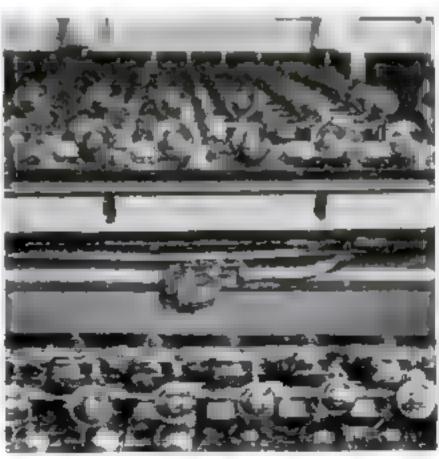


15 Here girls are putting the bulbs on racks in a machine for silvering and coloring. First, chemicals are sprayed up through the necks to give a mirrorlike surface inside . . .





16 ... then the racks pass through the dye vats where boths of brilliant color give them the outer tints of red, blue, green, gold, and silver that add sparkle to trees on Christmas Day



17 After, the dye has been dried quickly by heat, the necks are cut off by an automatic machine. Occasionally, however, one of the bulbs gets by the machine, it is the job of this girl to eatch such strays and cut off their necks by hand on a Carborundum wheel



19 Enough ornoments to cover a whole forest of Christmas trees are contained in these cartons stacked in a warehouse awaiting shipment. Two million are turned out every week



JANUARY, 1941



18 At the end of the long production line, the globes are sorted and broken ones are removed. Now they are packed in partitioned cardboard baxes





Here's My Story



CHEVALIER JACKSON WAS BORN IN PITTSBURGH IN 1865 WHEN ONLY A CHILD, HE BEGAN TO DEVELOP HIS WORLD-FAMOUS FINGER DEXTERITY! BY ASSUMING THE FAMILY TASK OF TWISTING PAPER INTO LAMP LIGHTERS



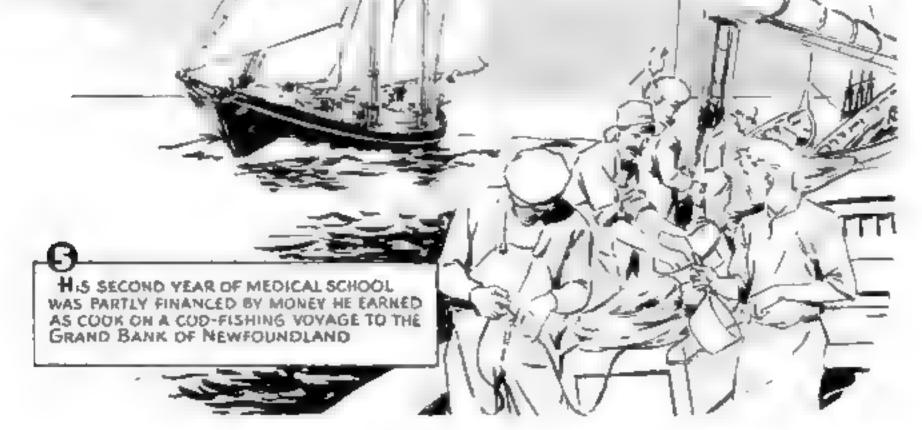
AT 12, YOUNG JACKSON DEVISED A HARPOON BIT TO RECOVER DRILLING TOOLS LOST 1500 FEET DOWN AN OIL WELL ON HIS FATHER'S LAND. THIS TOOL LATER BECAME WIDELY USED IN AMERICAN OIL FIELDS



LATER, HE SAVED VALUABLE PAPERS DURING A PLANING-MILL FIRE, AND WAS REWARDED WITH ENOUGH PINE BOARDS TO MAKE A SAILING CANDE IN HIS FATHERS HOME WORKSHOP, WHERE HE SPENT MUCH OF HIS TIME



TO EARN MONEY FOR HIS FIRST YEAR AT JEFFERSON MEDICAL COLLEGE IN PHILADELPHIA, JACKSON PAINTED CHINAWARE. HE WORKED WITH A BRUSH IN EITHER HAND, TO DEVELOP AMBIDEXTERITY



THE CAREER OF CHEVALIER JACKSON





On APRIL 2, 1886, HE RECEIVED HIS MEDICAL DEGREE AND BECAME DR. CHEVALIER JACKSON. YEARS LATER HE RETURNED TO THE COLLEGE AS A FACULTY MEMBER



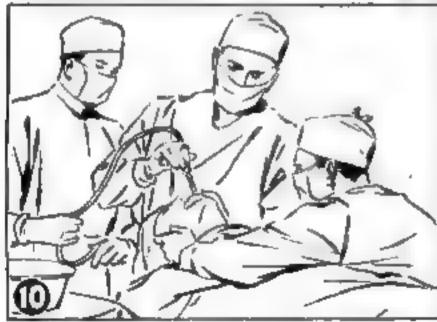
While returning in Steerage from a MEDICAL-STUDY TRIP ABROAD, HE VOLUNTEERED TO CARE FOR A PASSENGER STRICKEN WITH DREADED SMALLPOX. LOCKED IN A QUARANTINE CABIN, JACKSON SAVED THE MAN'S LIFE



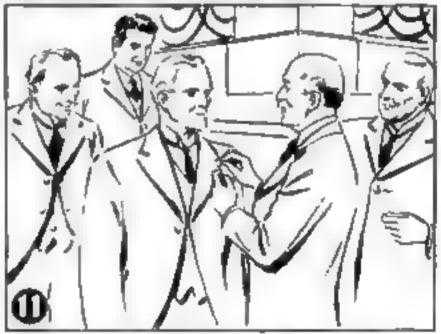
On his return to Pittsburgh, with only \$1.76 LEFT in his pocket, he began the practice of medicine. HE DECIDED TO SPECIALIZE IN THROAT AILMENTS



IN 1890 HE DEVELOPED A DEVICE FOR EXAMINING THE HUMAN ESOPHAGUS. FROM THIS GREW HIS FAMOUS BRONCHOSCOPE, A MECHANISM FOR REMOVING FOREIGN OBJECTS ACCIDENTALLY LODGED IN THE LUNGS. FORMERLY, 98 OUT OF 100 PERSONS SO AFFLICTED, DIED



IN 1928, HE TOOK CHARGE OF THE BRONCHOSCOPIC CLINIC AT THE GRADUATE SCHOOL OF MEDICINE IN PHILADELPHIA. HERE HE SAVED THE LIVES OF HUNDREDS OF PATIENTS, MANY OF THEM CHILDREN WHO HAD SWALLOWED COINS, PINS, OR OTHER OBJECTS



FOR HIS MARVELOUS WORK, DR. JACKSON HAS BEEN SHOWERED WITH HONORS, INCLUDING DECORATIONS FROM FOREIGN GOVERNMENTS, AND HONORARY DEGREES FROM MANY AMERICAN UNIVERSITIES

Blood for British War Victims Stored by American Red Cross



American blood for British war victime. Part of a shipment prepared for treatment of the wounded abroad



Draining blood from the veins of a volunteer donor. When the nurse opens a valve, the fluid is drawn into the vacuum bottle

LOOD by the gallon taken from hundreds of volunteer donors in this country is now being processed under the direction of the American Red Cross for shipment to England and ultimate use in the treatment of war casualties. When a supply of blood is drained from the veins of a volunteer donor, it is bottled and stored in a refrigerator where it separates, the heavier corpuscies settling to the bottom and the plasma, or liquid, watery part of the blood, rising toward the top. Further separation is accomplished by whirling bottles of blood in a centrifuge at a rate of 2,000 revolutions a minute. The plasma is then drawn off and mixed with a saline solution. In this form, the blood plasma can be handled, shipped, or stored for long periods of time without impairing its beneficial effects when introduced into

the blood stream of a person suffering from wound shock or hemorrhage. Another advantage is the fact that the plasma obtained from the blood of many donors can be mixed and is suitable for use with all persons, regardless of the type of blood they have, whereas with actual blood transfusions, care must be taken to see that the



How bottled blood is used during an operation. The doctor at lower right is ready to inject the plasma in the patient's arm

blood of the donor and that of the person who is to receive it are of the same type. The entire process of gathering, separating, and mixing the plasma is conducted under absolutely sterile conditions. In addition to this work, the Red Cross is laying plans for mobilizing blood donors into a nation-wide corps for service in any emergency.



Jan Norriss "making up" one of her mannequins. Note the lifelike appearance of the finished figure

Mannequins of Rubber Have Flexible Bodies

FLEXIBLE mannequins that have an exceptionally lifelike skin texture are the result of an invention by Jan Norriss, New York City sculptress. Miss Norriss pours

a mixture of chemicals into liquid latex, and shapes the result in molds. It can be bent, twisted, and stretched, but will return instantly to its original shape. Scrubbing does not mar the surface in any way. Ideal for use in making mannequins, the material may also be used for making artificial limbs, and nurses in training are given arms made of the rubber substance on which to practice hypodermic-needle injections.

"Electric" Paint Keeps Barnacles off Boat Hulls

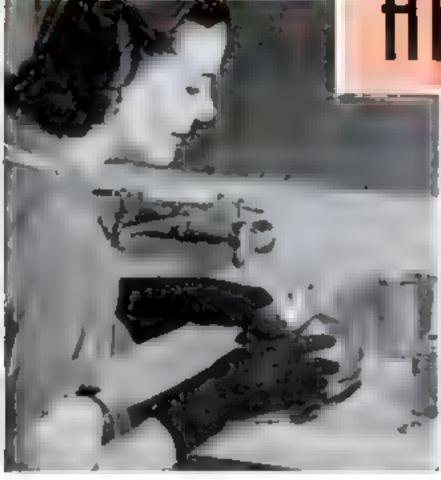
BARNACLES are said to be repelled from the bottoms of ship hulis by a paint developed by Capt. J. Stanley Cameron, retired Yankee skipper now of Long Beach, Calif. According to the captain, his paint creates an electrical turbulence around the submerged portion of a versel that discourages barnacles and other marine growths from attaching themselves to the hull.



Capt. J. Stanley Cameron explains how his point discourages barnacles

JANUARY, 1941 119

APPLIANCES FOR



HOUSEHOLD GLOVES coated with Neoprene, a synthetic rubber product, are handy for dishwashing, cleaning, gardening, and many other tasks about the home. Water-resistant, they are said to be more comfortable than ordinary rubber gloves

supplied with an elastic rubber line designed for use indoors or while traveling. Shown below, the hooks hold the daintiest garments without injury

CLOTHESLINE HOOKS of plastic material are





DARNING EGG FOR GLOVES. Mending a glove finger is simplified by the use of this "darning egg." Made of plastic, it comes in three colors



KNIFE SHARPENER IS ADJUSTABLE

By moving a button on the sharpener at the left, the blade rest is set at the proper angle for sharpening carving knives, paring knives, or table knives, as required METAL MIRROR. Nobody can get seven years' bad luck by breaking the mirror below. It is made of sheet steel with nickel-chrome coating. Maist air does not harm it, so it can be used in the bothroom without rusting





CANNON BEVERAGE MIXER. Guests are sure to be amused by this novel beverage mixer, which resembles a miniature brass ship's cannon. Appropriate glasses have feet representing small connon balls

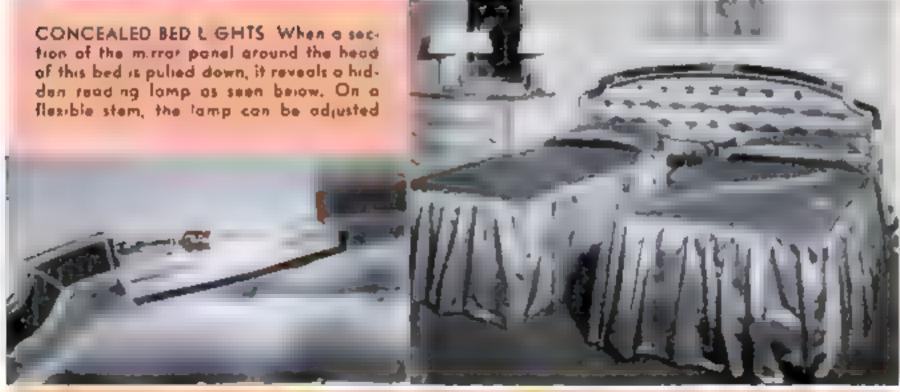


BOTTLE STOPPER

For keeping "fitt" in opened bottles of carbonated drinks the compact stopper at the left can be tightened or loosened by turning a winged lever at the top. A rubber disk on the inside seals the cap



CORN ON THE COB is served in style with this set consisting of two forks for spearing the ear, an earthenware put and brush for butter, and a plate



America Starts Work on World's Biggest Navy

By ALDEN P. ARMAGNAC

TTHIN four years the war fleet of the United States will be the mightiest armada the world has ever seen. Three hundred and thirty new ships, added to the present 348, will give us our long-awaited two-ocean navy, a fighting force capable of defending both coasts simultaneously.

The new warships—17 battleships, 48 cruisers, 12 sircraft carriers, 171 destroyers, and 82 submarines—will represent the last word in the evolution of fighting craft, and innovations among them may foreshadow the whole future of naval warfare.

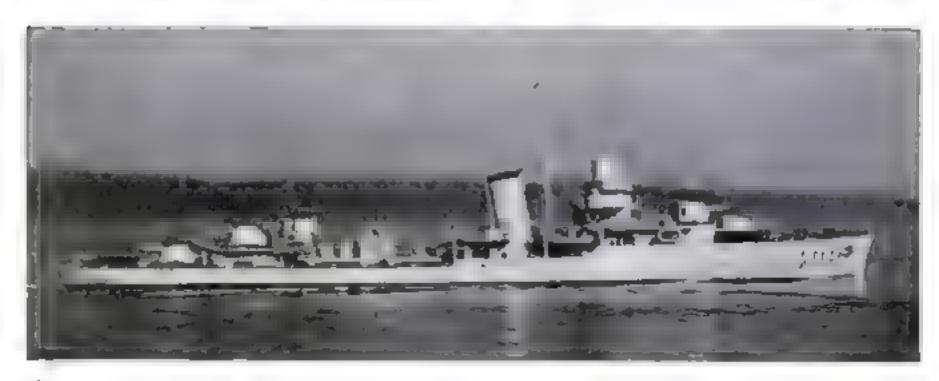
Of the seventeen battleships, the first six will be of 35,000 tons and carry nine sixteeninch guns spiece in their main batteries. They will be the biggest, most powerful, and speedlest battleships we have ever built. Two of them, the North Carolina and Washington, have been launched and are due for completion in 1941. Keels have been laid for the rest—the South Dakota, Indiana, Massachusetts, and Alabama.

In appearance, their most striking feature will be their conical masts, rising like lighthouses to present a new silhouette against the sky. Cage masts, once typical of U. S. battleships, proved too unsteady for mounting precision fire-control instruments. Tripod masts, which superseded

them, were steadier and could have one or even two legs shot away-but fell with the loss of the third. More recently has appeared the bridge-and-tower structure, typified in our modernized Idaho and England's Nelson, whose tars have named it "Queen Anne's mansions" for its resemblance to a group of London flats. With the modern trend away from elaborate superstructure that an air bomb could turn into splinters of flying steel, styles for battleships have changed again, and the cone mast is the result. It houses fire-control apparatus that trains the big guns; a stubbier mast aft allows unobstructed antiaircraft fire.

Even greater battleships are soon to come. The superdreadnought lower now building at the New York Navy Yard will be followed by the New Jersey, Missouri, Wisconsin, and seven more, all of 45,000 tons or larger. They will outclass at least four and probably eight battleships of 40,000 tons or more that Japan now is believed to be building.

First descriptions of the Jowa, New Jersey, and their sister ships indicate 45,000-ton size and an armament of nine sixteeninch guns, the same as for the smaller North Carolina class. The difference in tonnage would be used to increase the speed of the larger ships. But plans for later battle-ships of the program, at least, may be revised. Recent Navy studies favor increas-

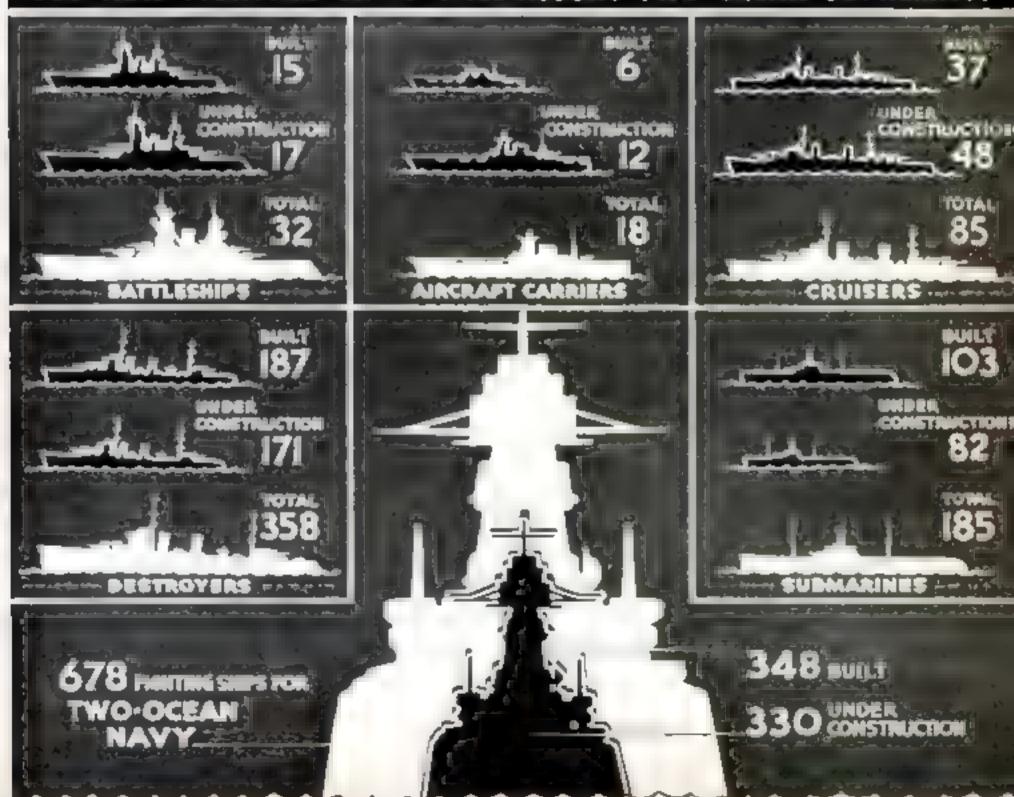


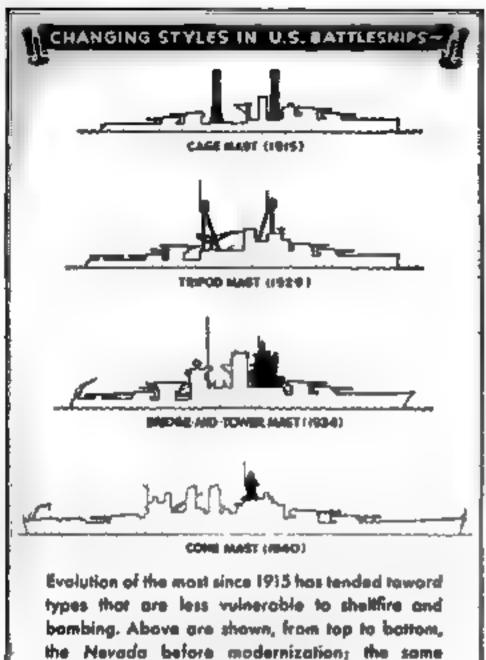
Sleek new destroyers like the Wilson are going into service as much as seven months ahead of schedule



Modernising of older ships is a part of the program. Here the Idaha shows her bridge-and-tower' foremost

330 NEW FIGHTING SHIPS WILL ASSURE TWO-OCEAN SUPREMACY





types that are less vulnerable to shellfire and bambing. Above are shown, from top to battom, the Nevada before modernization; the same ship as rebuilt in 1929, the idaho after modernization in 1934, and the big, new North Carolina

ing the monster size of these floating fortresses to 50,000 or 52,000 tons, with perhaps twelve big guns. Also, it recently has been revealed that the Navy is experimenting with an eighteen-inch gun, the most powerful in the world. Proving-ground tests will determine whether it may be adopted for use on our biggest ships.

Twelve aircraft carriers in our two-ocean naval program will benefit from our experience with a wide variety of types. "The bigger, the better" doesn't seem to hold true for vessels of this category. Carriers are admittedly the most vulnerable of warships, and naval circles believe that the big, 33,000-ton Lexington and Saratoga carry "too many eggs in one basket" for comfort. Conversely, the 14,700-ton Wasp, which used up the tonnage allowed us for carriers in a treaty now expired, is regarded as smaller than the ideal size.

So the Hornet, Essex, Bon Homme Richard, Intropid, Kearsarge, and seven more of our new carriers are expected to be patterned more nearly after the 20,000-ton Yorktown and Enterprise, completed in 1938. These highly satisfactory craft can carry 100 planes apiece, and are credited with the high speed of more than thirty-two

knots. To save time in bringing aircraft up to the flight deck in an elevator, some can be launched by cataputt from the hangar deck below. Despite the claims of speed upon tonnage, enough weight is left over to provide light armor, and also torpedo protection—an advantage emphasized by the torpedoing and sinking of the British carrier Courageous.

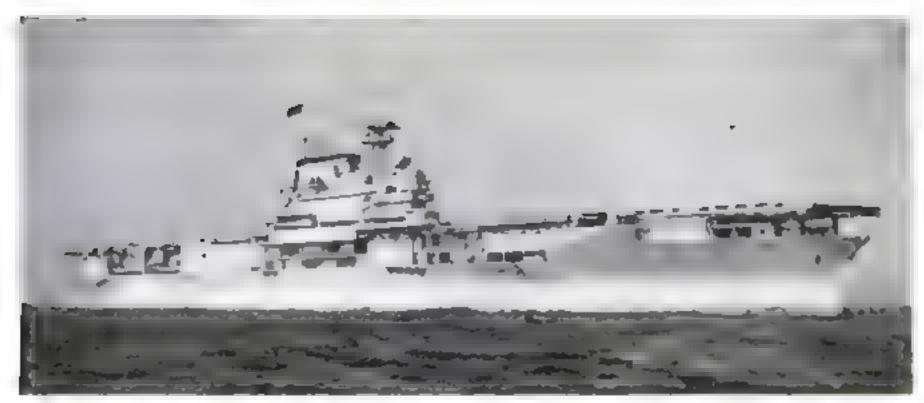
New cruisers will include many sizes and types. One of the most interesting is a new 6,000-ton design, smallest built for the U.S. Navy in many years. Exceptionally speedy and economical, these ships should prove ideal for convoying and patrolling shipping lanes. Four of them, the Atlanta, Juneau, San Juan, and San Diego, were laid down in 1940. At the other end of the size range, we may expect enlarged editions of the 10,000-tonners we have been building, whose latest examples are the eight-inch-gun Wichits and the six-inch-gun Helens.

A total of 171 destroyers in the current building program will replace, many times over, the fifty old ones that were traded to Britain for invaluable naval bases. Among the latest in service, the largest can fire the world's heaviest torpedo salvo to either beam from their twelve deck-mounted tubes. U. S. destroyers now better forty knots, zigzag with incredible re-

sponsiveness to a touch on their electrohydraulic steering controls, and come to a "crash stop" from full speed ahead in less than three times their own length. Similar or better performance may be expected of the ones under construction, which are likely to follow a world-wide trend toward larger dimensions—constantly narrowing the distinction between destroyers and small cruisers.

Most of eighty-two submarines now contracted for, will be of the "fleet type" of about 1,500 tons, capable of extended ocean cruises either with the battle force or as lone commerce raiders. Orders also include, however, a new type of only 800 tons which would be used for coastal patrol,

O'VER and above these 330 fighting ships of the principal naval categories, we are building a host of minor warships and auxiliaries, scarcely less essential. Under construction at the Philadelphia Navy Yard, the 6,000-ton U. S. S. Terror will be our first mine layer specifically designed for the purpose. In the last war, merchant ships were acquired and converted into mine layers. Other items on the Navy's shopping list include "mother ships" for destroyers and sub-



Model for new aircraft carriers is the Yarktown. She launches planes from both catapults and deck

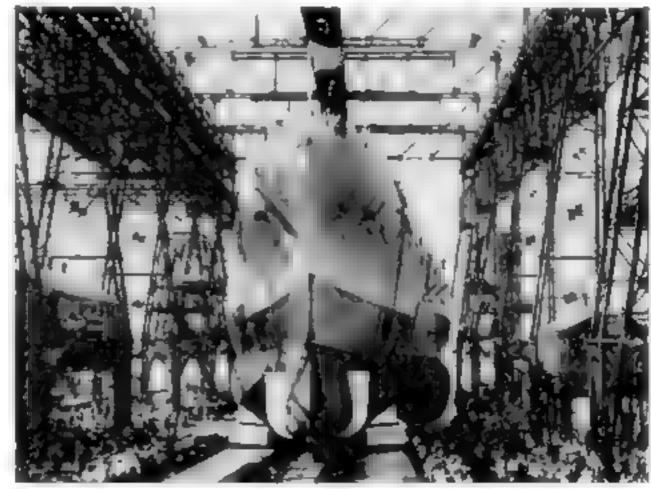
marines, armed landing boats to ferry men and thirty-mile-an-hour tanks ashore on a beach, a mosquito fleet of sub chasers and motor torpedo boats, and ships to lay and tend antisubmarine nets at naval and commercial harbors.

WHEN will the Two-Ocean Navy be completed? Normally it takes four years or more to build a battleship, three years for an aircraft carrier or cruiser, and two years for a destroyer or submarine. Also, all the country's shippards lack capacity to handle at once the vast order they have received. But erecting new shipbuilding ways, and adding extra shifts of workers, toiling at night under the glare of flood-lights, is speeding up the program almost to

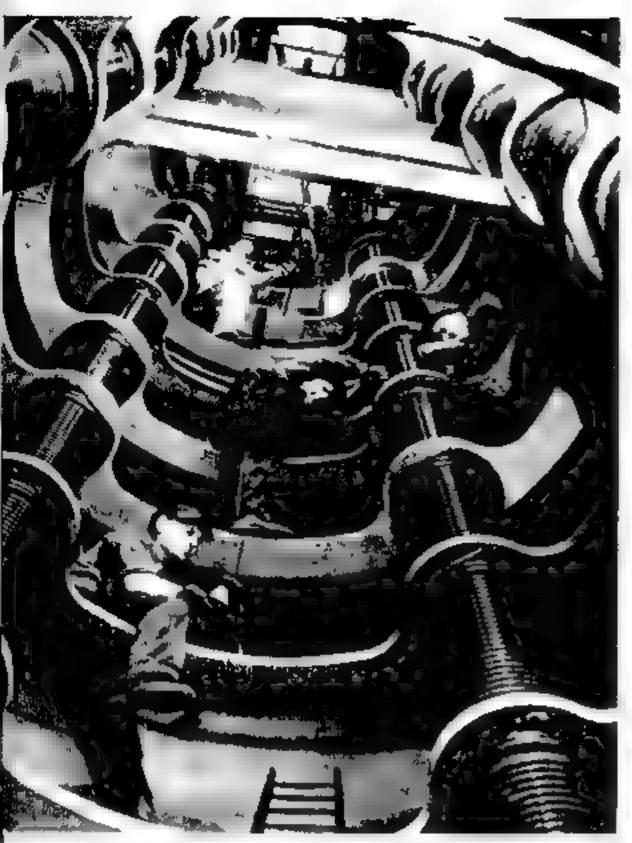
wartime pace. Originally it was expected to be finished by 1946, but Admiral Harold R. Stark, Chief of Naval Operations, now predicts that at least the bulk of the ships will be ready by 1944.

To take care of whatever may happen in the meantime, the Navy is making the most of every available craft, new and old. Pending completion of the new naval air base at San Juan, in Puerto Rico, the ancient and demilitarized battleship Wyoming has been restored to duty as a tender for long-range patrol planes. Many private yachts, sold or presented to the Navy by their owners, are being refitted as patrol vessels. Thirty-six old submarines are being put back into service. Recommissioned destroyers have been converted into "aircraft destroyers" and speedy troop transports.

Thus, ready to meet any emergency, the fleet stands guard—constantly reënforced as the new fighting ships come sliding down the ways. We shall not have to wait until 1944, or any other year, to see a fleet of warships handed over to the Navy at one grand stroke. More and more often, we shall see those little headlines about a new submarine launched, or a destroyer commissioned. Each one serves as a reminder that our Two-Ocean Navy is already materializing before our eyes.



Latest developments in naval design appear in the North Carolina here being launched. Note the bulbous bow and anti-torpedo buiges at sides



Inside a 65-fact atom smasher, From "Science Picture Parade"

Story of Science Told in Pictures

A KALEIDOSCOPIC outline of science, from archeology and atom amashers to weather and war, is presented in graphic form in "Science Picture Parade" by Watson Davis, director of Science Service and editor of "Science News Letter." With 302 photographs from the files of the service, brief chapter introductions and clearly written captions, Davis outlines the progress and knowledge of the earth's inhabitants since prehistoric days.

Though the chapter on war contains photographs of war machines and the men behind the machines, the book is free from horror pictures. It is in itself a tribute to the science of photography, for without modern cameras and films, many of the illustrations in the book, such as those splitting a lightning flash into its component parts, and stopping the wings of an insect in flight, would be impossible. Speaking of insects. Davis notes that the mosquito is rated as No. 1 insect enemy of man in the United States, doing an estimated \$145,000,000 worth of damage yearly. The boll weevil accounts for \$121,000,000 damages annually, (Price, \$3.)

Books Show How Houses Are Built, Sails Are Made

THIS IS THE WAY WE BUILD A HOUSE, by Creighton Peet, is addressed directly to young readers, but it should find an enthustastic audience among older persons who are not too sure they know the difference between rafters and joists, and would be hard put to answer Junior's embarrassing questions. In words and pictures, the book follows the growth of a house from the first steps of digging the cellar to the final stages of its finishing touches. Some idea of the way in which the author treats his subject may be gained from the text beneath one picture showing Billy and Tommy examining a jagged-edge hole in the rough flooring of their unfinished house. " ... Billy and his kid brother saw that they had left a jagged, uneven hole where the inside cellar stairs were to go. Tommy asked why they did this, and Billy said he guessed they would saw

the ends off and make a smooth hole when they were ready to put the stairs in. They found out later that stairs are almost always built in a lumber mill and brought to the house in sections." (Price, \$2.)

satimating simplified, by Alan Gray. For years, professional sailmakers have kept their methods of cutting, shaping, and sewing sails a dark secret. But now, according to the publishers, the secrets are fully revealed in this 134-page volume, addressed to the thousands of men and women who count sailing their hobby. Tables, charts, diagrams, and photographs supplement the text. (Price, \$2.25.)

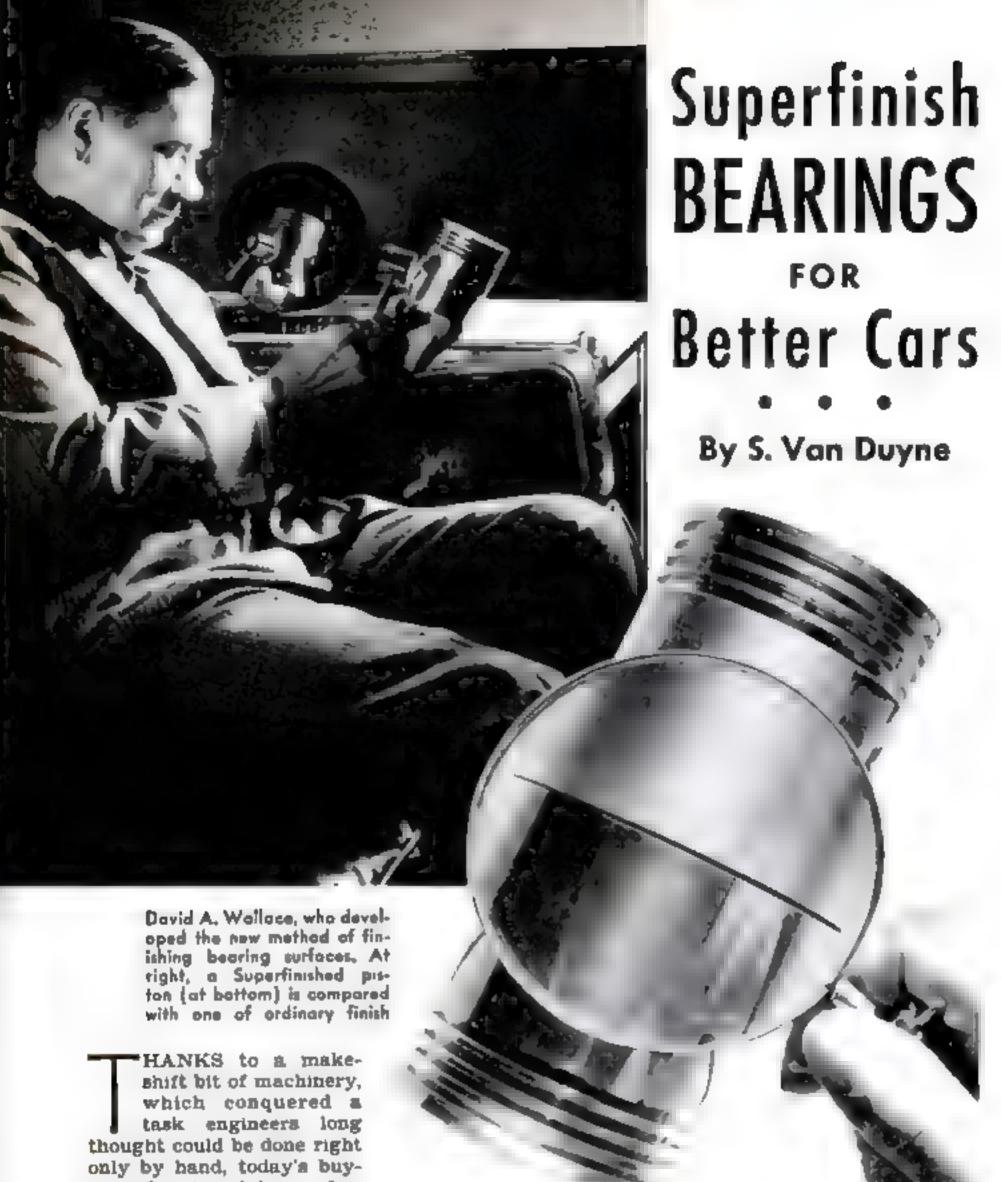
If your bookseller cannot supply the book you want, send your order with remittance to Book Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York City.

AUTOS



Science's latest weapon in the war on friction—SUPERFINISH PARTS

nest mee



ers of automobiles and a long list of other machines are getting smoother and more economical perform-

ance from their purchases than ever before.

That device duplicated, during the finishing of certain metal surfaces, the random motion and the light pressure exercised by a skillful man in the laborious and costly process of hand lapping. Its success makes it possible to give that same hand-finished excellence to bearing surfaces on a massproduction basis. That's why the chances are good now that the car you drive has Superfinished bearing surfaces in it somewhere.

It all started five years ago when new automobiles from the Chrysler plant turned up in railroad freight cars on the West Coast with damaged rear-wheel bearings,

Dealers squawked, of course. Trouble shooters from the company's great Jefferson Avenue plant in Detroit got on the job. They learned that the incessant pounding of freight car wheels over rail joints and switches was to blame, and that no manner of blocking up the automobile wheels lessened the damage. They discovered that under that pounding from the rails the hard, antifriction rollers on which the wheels of automobiles rest were hammering dents into their roller cups, or bearing "races." This caused a bothersome grinding noise when the cars were in motion, and it brought the necessity of replacing all damaged bearings.

The job of licking the problem fell to David A. Wallace, president of the Chrysler Division of the Chrysler Corporation. In his laboratories, microscopes showed that the dented cups were "brinelled," a condition resulting when any hard, round surface is forced against a softer one. But the microscopes also revealed a metallic fuzz on the entire surface of every cup, left there by the grinding wheels that originally finished them.

Wallace reasoned that it was this fuzz that broke down under the abnormal stresses of freight-car travel. He knew that hand lapping removed this fuzz. He proved his point by installing hand-lapped cups in some wheels. When automobiles so equipped were shipped to California by rail, the cups were as good as new on arrival.

But slow, expensive hand lapping of every bearing was out of the question. And so Wallace rigged up something new out of an old drill press and a few abrasive stones.

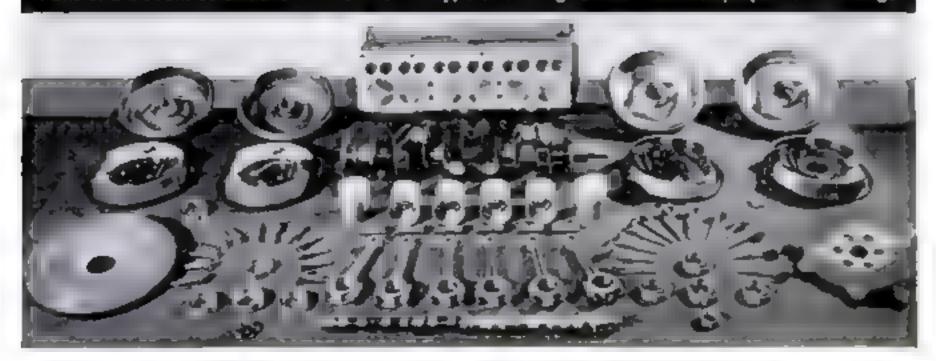
To help understand its action, Wallace compares it with the operation of finishing machines used on jobs that do not require Superfinished precision. They were, mainly, "turning" and "grinding" machines.

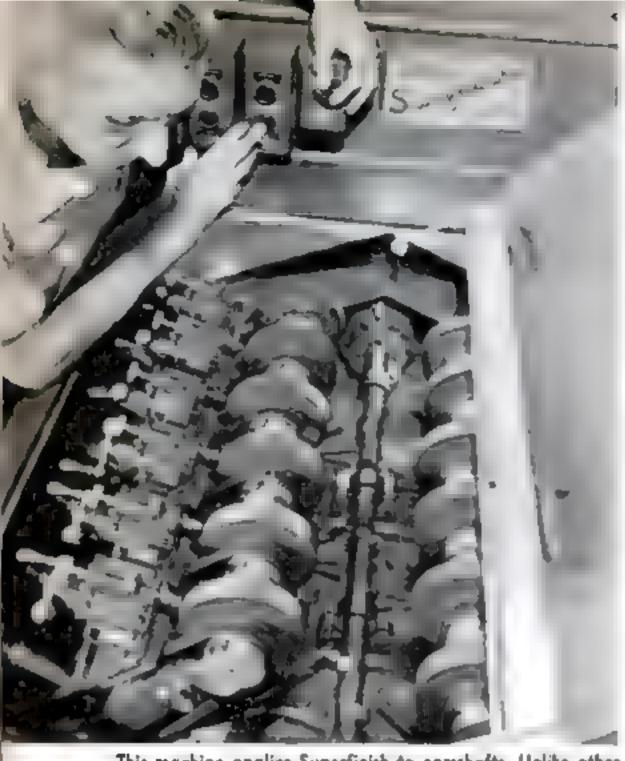
Turning means that the bearing or other object being worked on is revolved at high speed and pressure against the tip of a sharp cutting tool which slowly advances across it, shaving it down to the desired size. It leaves grooves like those on a phonograph record. Grinding is similar, except that in place of the sharp tool, a rapidly turning abrasive wheel is pressed against the rotating work. This also leaves grooves, although they are barely visible. Grinding is conventionally applied to already turned surfaces.

But the high speed and pressure of both turning and grinding generate heat from friction so intense—often reaching 2,000 degrees F.—that even quantities of cooling liquid cannot reduce it below the softening

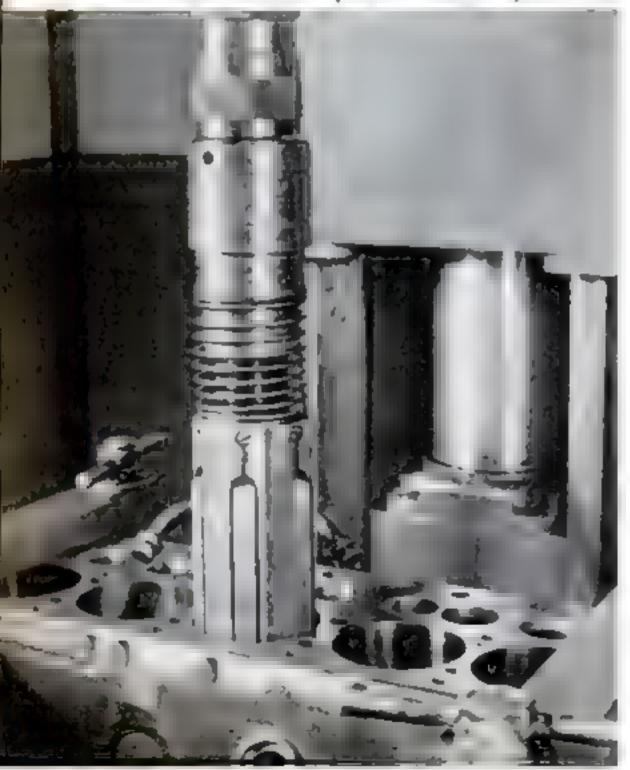
How Superfinish compares in method and results with the work done by ardinary finishing machines

Parts of a modern automobile in which the new type of hearing surface can be employed to advantage





This machine applies Superfinish to camshafts, Unlike other applications of the process, it uses fixed abrasive wheels. The drill-like tool below puts the finish on cylinder walls



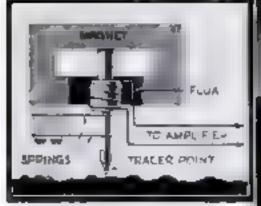
point of the metal at the point of contact. The heat softens the cementlike substance that binds the metallic crystals together, permitting them to be torn loose rather than cut flat by the action of the cutting tool or grinding wheel. The result is the troublesome fuzz. Yet if the causes of the heat—pressure and speed—are eliminated, no metal can be removed by such methods as turning and grinding.

But Wallace's machine revolved slowly. It used light pressure over a wide area. And it applied it with a peculiar random motion, equally as random as the motion of a man's hand during hand lapping, while oil from a nozzle washed away abrasive dust and tiny bits of metal.

If we liken the unwanted fuzz to tall peaks and deep valleys in mountainous country, it will be easier to see what Wallace's machine accomplished. Obviously his drill-press stones began their work on the tops of the highest peaks, which they began to lop off. As they did so, tiny flat plateaus appeared where the highest points were cut off—not melted and broken. The pressure was light, so there could be no heat. The abrasives were scraping off the tops as a grader might scrape high spots from a plowed field, or as a hoe might remove snow from ice. Presently, what had been a surface of peaks and valleys was covered with wide plateaus separated by only a few of what were formerly the deepest valleys, now grown narrow, Most important of all, the plateaus were all smooth, level, and of the same height. And the remaining valleys measured but a few microinches-millionths of an inch—in depth.

Wallace recognized this as the type of surface automobile engineers hoped for when they assembled bearings to tight fits and then "broke them in" to looser fits by careful running. Cylinders and pistons, valve stems and guides, crankshafts and connecting rods, and many other "mating" bearing surfaces in cars and other machines, he reasoned, could now be made to desired clearances to start with.

But this same simple drill press had still another secret to reveal, Operated at a fixed stone pressure,



To check the smoothness of surfaces, the profilemeter records irregularities in fractions of a microinch

it would level off a bearing's roughness and then, almost miraculously, it would stop cutting. Careful study revealed that at first

contact with the rough work, the stones ground the peaks away rapidly. But as the plateaus broadened, the stones began to glaze. After far less than a minute, the plateaus reached maximum width, and the stones became glazed to the point where they no longer possessed abrasive qualities. Even days of constant operation would remove no more metal. Yet, as soon as a new piece of work was placed under the stones, its rough surface instantly removed the glaze—dressed the stones, in shop language—and the grinding-polishing cycle started over again. Thousands of Superfinishing jobs could be handled before

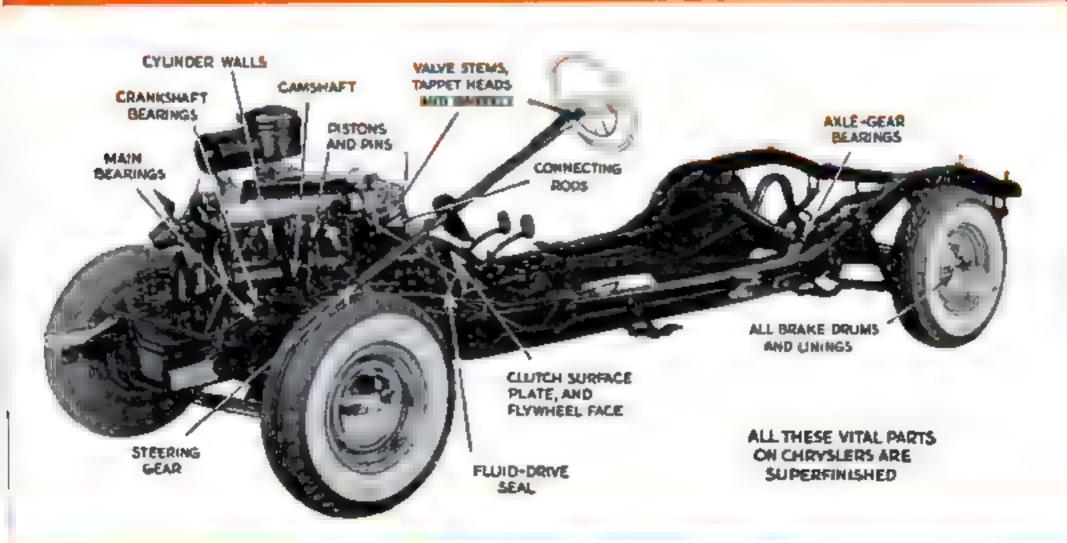


it would be necessary to replace the stones. Experiments went forward and improved machines were made. When their practicality was proved beyond doubt, Wallace decided to act. By this time, the full possibilities of Superfinishing were clear. It would benefit many industries, including his own. His business was building cars, not tool making. And there was still much de-

going and do it the quickest way?

He summoned a group of machine-tool makers to Detroit and revealed all he had done. Within a short time they were attacking the problem of turning out ma-

velopment work to be done. Why not get





A simple test of the smoothness of a surface is to rub it with a table-tennis ball set in a doctor's stethoscope. On a Superfinished surface, hardly any scratching can be heard

chines, essentially like his converted drill press, to do the job of Superfinishing. For they also saw that if a Superfinished rearwheel bearing was better than any existing machined bearing, other Superfinished bearing surfaces would be better, too.

And better bearings were being sought in many fields. As proof of this, Wallace told the writer a few weeks ago that the same brinelling problem he faced five years ago was then also worrying the makers of variable-pitch airplane propellers. The propeller hubs, it was found, were brinelling under the pounding vibration of engine torque. Oddly, the wheel bearings of planes were brinelling too, he said, while carrying nothing but the weight of the wheels during flight. Makers of Diesel engines were searching for a smoother crankshaft bearing to stand up under the terrific cylinder compression-often three times that of average gasoline engines—that Diesels require. A sewing-machine maker had reached the limit of his ability to increase the speed of his machines with assurance against bearing failures.

Chrysler motors were then being "run in" for three hours on blocks. Valve tappets and the surfaces of valve stems in internalcombustion engines were an everlasting headache to engineers who strove to finish them to clearances that gave quiet operation with adequate lubrication.

Wallace hardly had to enumerate such problems to the experts he had invited to Detroit. What he wanted, he told them. was quantities of machines to do any number of Superfinishing jobs. The conference not only brought the experts' approval, but a blanket come-and-sec-it invitation soon afterward touched off a modern-day pilgrimage of scientists and engineers to Detroit. Men came from shops, big and little, from executive offices of dozens of industries, from schools, colleges, and research laboratories, and from bureaus of many governments. More than 7,000 experts came, listened, and went away "sold" on Superfinish.

Among the first to act were the abrasive makers, who began studying new ways of bonding together the tiny particles of many different abrasives into solid stones. Lubricating engineers from oil companies evolved new formulas for lubricants that would work best with

the best stones. In time, combinations of stones and lubricants best adapted to the Superfinishing of both metallic and non-metallic materials were worked out. And one by one, Superfinishing machines to use them were perfected by the machine-tool makers. Finally, to test and measure Superfinished surfaces, a compact, portable device called a Profilometer was designed that would quickly show on a dial the average depth of irregularities on the fine surfaces, and record them down to fractions of one microinch.

As early as 1937, David Wallace saw the first cars come off the Chrysler assembly lines with Superfinish wheel and crankshaft bearings. Today, dozens of vital parts on Chrysler-made cars are Superfinished, with a promise of durability far exceeding anything dreamed of a half dozen years ago. Airplane engines, propellers, and wheels are giving longer, better service with Superfinished parts. A sewing-machine maker is producing machines that operate safely at from two to three times their former top speed. Chrysler motors are now "run in"

for less than a half hour, and scrapping of parts that occasionally failed before has been cut almost to the vanishing point.

An outstanding feature of a Superfinished surface is the fact that it can be made to increase friction as well as to decrease it. The explanation lies partly in the factor of lubrication, partly in the surface itself. For all friction surfaces or bearings act as efficiently as they do because oil, the lubricant, actually holds them apart during op-

eration. We have seen that a Superfinished aurface consists of a great number of relatively broad, level plateaus of equal height. If all lubricant is removed from these plateaus in two "mated" surfaces, the plateaus will contact one another. And the total contacting area is proportionate to the size and smoothness of the plateaus. As this area increases-minus a lubricant - friction increases too.

In view of this, it became apparent that friction surfaces in cars, such as brakes and clutches, might well be Superfinished for better efficiency. So among the available Superfinishing machines today are those for smoothing clutch plates and brake drums, and clutch and brake linings.

In the rolling mills of ateel companies, huge rollers that squeeze out strip steel are Superfinished, to give smoother surfaces to their products. Plastic makers are getting products from Superfinished dies that don't even have to be buffed. At least four other makers of popular automobiles are solving old bearing problems with Superfinishers.

Three of the largest tractors makers have added thousands of hours of service to the crankshafts and other heavily loaded parts of their Diesel engines—with Superfinish. The list could go on and on, and it continues to grow at exactly the rate that six of the nation's busiest machine-tool-making companies, licensed under Wallace and Chrysler patents, are able to supply Superfinishers.

"Wallace's hobby," some of his friends call Superfinish.

They say it reverently!



This ingenious machine puts Superfinish on cronkshoft bearings. Arms carrying obrasive stones move synchronously as the cronkshoft turns

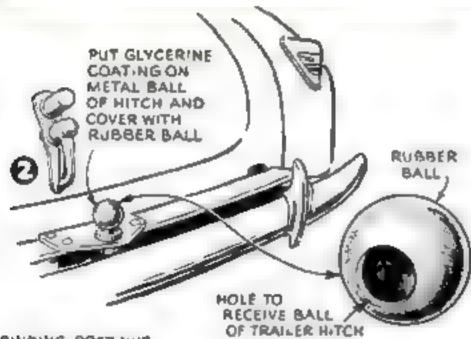


Here is a close-up of the finishing action. The abrasive stanes move from side to side as the shaft revolves slawly in contact with them

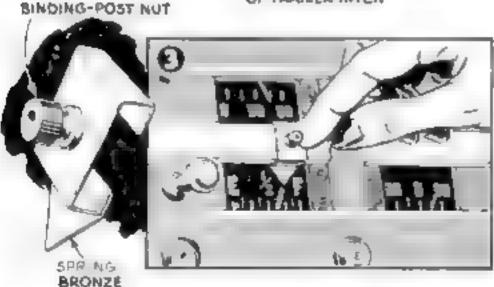
THINGS TO DO AND



A HEADLIGHT BEAM INDICATOR mounted on a front fender where you can see it from the driver's seat, even while driving in brightly illuminated city streets, is a valuable aid to nightdriving safety. Using an electriclighted fender guide, simply connect it to the high-beam circuit of your headlights. Whenever this beam is working, the fender guide will shine and keep you constantly reminded of the fact that your headlights may be blinding a driver approaching from the opposite direction—S.J.H.



2 WINTER PROTECTION AGAINST RUST for the ball of a ball-and-socket trailer hitch is assured with the simple expedient of cutting a hole in a bollow rubber ball of adequate size, covering the metal ball with glycerin, and forcing the cut-away rubber ball over it. With a little care, you can get a leakproof fit in the rubber ball, Glycerin is suggested because ordinary grease or oil attacks rubber.—J G.



3 CHECKING GASOLINE CONSUMPTION OR a trip is made easier with a handy pointer set right over the gasoline gauge on the dashboard of a car. Made of a strip of sheet metal, the unit is cut and bent to the shape indicated in the sketch at the left. A binding-post nut from a dry cell is soldered to the unit as a handle. On some cars, the division bar over the dial face may be used to mount the unit so that it can be slid from side to side. If no such bar exists, it is easy to make one from metal and bolt it in place. To use the device, set the pointer over the needle of the gas gauge before a trip. At the end of the trip, the space separating the pointer and needle tells how much gasoline has been consumed.-WB.



4 WAX AND FOUSH ARE APPLIED to a car much more easily if cheap fleece-lined work gloves are turned inside out, put on the hands, and used in place of rubbing cloths for the job. A bigger rubbing surface is afforded than if folded cloth is used, and it can't slip from the hand.—E.M.

MAKE FOR YOUR CAR

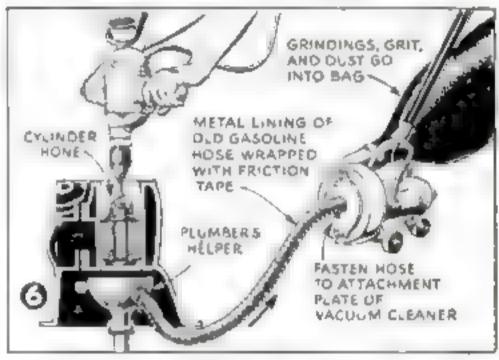
5 AN Oil Drain Pan that slides under even the low-slung new cars can be made for nothing out of a square five-gallon oil can. With a pair of sheet-metal shears, cut the can approximately as shown, leaving sides that will fit under your car's crankcase drain hole. Leave the handle attached to the top to simplify removing the pan from under the car.—W.C.A.

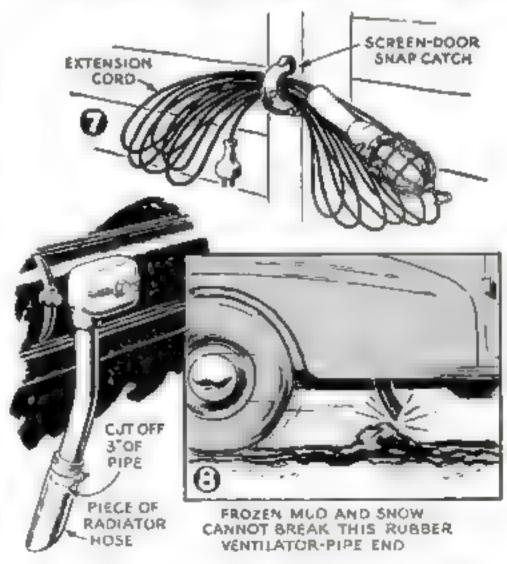
6 FOR KEEPING ABRASIVE DUST and minute particles of metal resulting from cylinder-honing operations from entering various openings in an engine block where they would be hard to clean out, I rigged up an old vacuum cleaner with a length of the metal lining of a worn-out gasolinepump hose and a plumber's helper, as shown in the accompanying sketch. The plumber's helper is easily set below the cylinder opening of each cylinder in turn. Before starting to hone, I turn on the vacuum cleaner, which effectively sucks all the harmful particles into the dust bag. I found it a simple matter to rig up a coupling to connect the hose to the attachment plate of the cleaner. If it is preferred, the cleaner can be made to exhaust through additional hose to the open air.—C.E.C.

7 10 HOLD AN EXTENSION CORD on your garage wall when it is not being used, a screen-door snap catch of the type illustrated is handy. Mount it with the hinged arm pointing upward when released. Then a flip of the hand is all that is necessary to open it outward for hanging up the coiled cord. Flipped back again, the catch holds the cord securely against the stud or wall to which it is fastened.—A H.W.

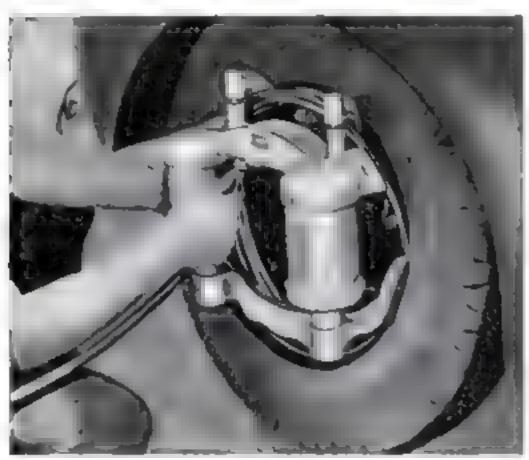
gice and snow can't damage the lower end of your crankcase ventilator pipe if it is replaced with a piece of radiator hose. Cut off about three inches of the lower end of the pipe and fasten the hose on tightly with a clamp. Chunks of frozen mud or snow, extending above the road surface and striking the rubber hose, will simply bend the hose without harm.—C.L.



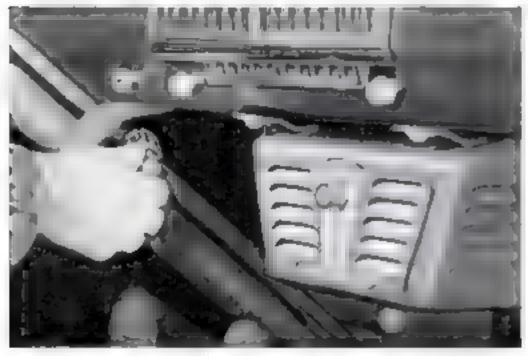




Without taking either hand from the steering wheel, the driver can tune her car radio by simply pressing a foot switch



How a tire is put back on a rim with the compressed-air unit. It grabs the bead and forces it safely and quickly into place



Conveniently located on the steering column, the adjustable thermostat keeps air in the car at any desired temperature.

Switch Set in Floor Tunes Auto's Radio

TUNING your car radio is now accomplished without taking your hands from the steering wheel with a system just worked out by radio engineers. Available on several 1941 automobiles, of which one is the Nash shown at the left, the tuning control consists of a floor push-button switch operated by the toe of your shoe. The switch is connected to a magnetic control built into the radio to select the program of your choosing. Held down, the switch reduces signal volume of any station, much as a floor switch dims the headlights.

Air-Powered Device Puts Tire on Rim

AIR supplied by any servicestation or garage air compressor now does the work of mallets, tire irons, and elbow grease in mounting tires on rims. Applied at the valve of a pneumatic machine, the compressed air enters cylinders to force pistons outward against flanges which guide the tire beads over the edges of wheel rims and drop them into place. The machine is said to work without danger of plaching inner tubes or scuffing tire casings. Moreover, it makes it unnecessary to remove a wheel from a car to change a tire, the manufacturer claims, it being but a matter of seconds to mount a tire.

Thermostat Governs Temperature in Car

THERMOSTATIC control of the temperature inside cars is made possible, just as it is in homes, with the heater and controls shown installed in a Hudson. The equipment includes an adjustable knob mounted on the steering column which may be set at any desired point to suit the preference of the car's occupants. Once the heater is turned on, the automatic thermostat takes over the job of maintaining a uniform temperature.





Checking a Diesel's compression. Right, meter on engineer's lap tells temperatures throughout the motor

Road Tests Check Qualities of Motor Fuels

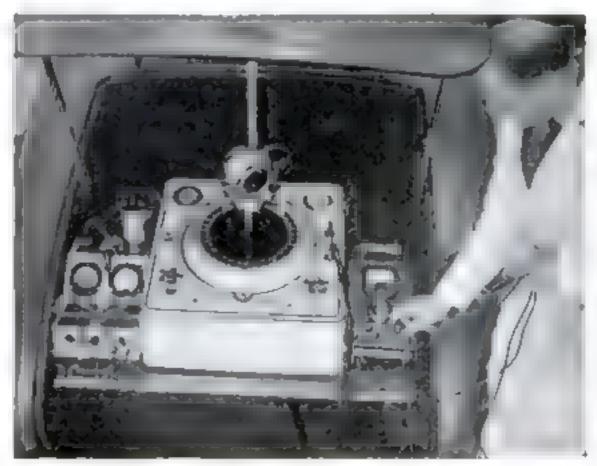
OW rapidly does a car pick up speed with a given type of gasoline? What is the compression of this or that make of Diesel engine with a certain fuel? How high are the temperatures at various points throughout a motor in service?

Using a variety of check-up devices, sales engineers of the Standard Oil Company of

California invade deserts and mountains to test the performance of gasoline and Diesel-engined vehicles. With cars of various makes and models, the engineers load their trouble-shooting devices into rear trunks, packed compactly on sponge rubber to prevent damage from vibration and jolting. For some tests they fill their front seats with as many as five pieces of apparatus. Their equipment includes gauges for recording motor temperatures, performance meters to show accurately the condition of motor and brakes, vacuum gauges to record load-pulling capacities of an engine, gasoline-mileage indicators, and exhaust-gas analyzers.

In other tests, special in-

struments developed by the U.S. Navy measure the compression of each cylinder of a Diesel engine under varying conditions of load and speed. And the engineers regularly give motors a scientific going over with various fuels, much as a doctor would put a patient through exhaustive tests to discover his reactions to a special diet.



Here a trunk of a coupe is loaded with portable apparatus for analyzing the engine performance of vehicles in grueling road tests.

12 Rules for Tire Health

O YOU race your car up to traffic lights and then slam on your brakes? Do you take corners at high speeds? Gun your motor in second or low? Or bump into or over curbs? If you do, your annual tire bill is from twenty-five to fifty percent higher than it should be, according to studies made by tire engineers of the B. F. Goodrich Company, of Akron, Ohio

And even more important, such treatment may well lower the high factor of safety built into your tires to protect life and property—your own and other people's!

Years of research and millions of dollars.

Years of research and millions of dollars have gone into the design of tires that today carry your car over rough mountain roads and high-speed superhighways with equal safety and freedom from trouble. But like

the automobiles that ride on them, they will stand neglect for a limited time only. Once they become weakened or damaged by neglect or abuse, they are as dangerous as worn-out brake linings that no longer will stop your car quickly, or a cracked axle that might break when least expected.

To help drivers maintain their tires in good condition at all times, Goodrich engineers have compiled a set of simple rules which they believe will help motorists to prolong the life of their tires and reduce the number of accidents due to tire failure. The twelve rules, consisting mainly of don'ts," are presented on the opposite page.

opposite page.

It costs plenty to neglect to keep your tires pumped up. Remember, air's free

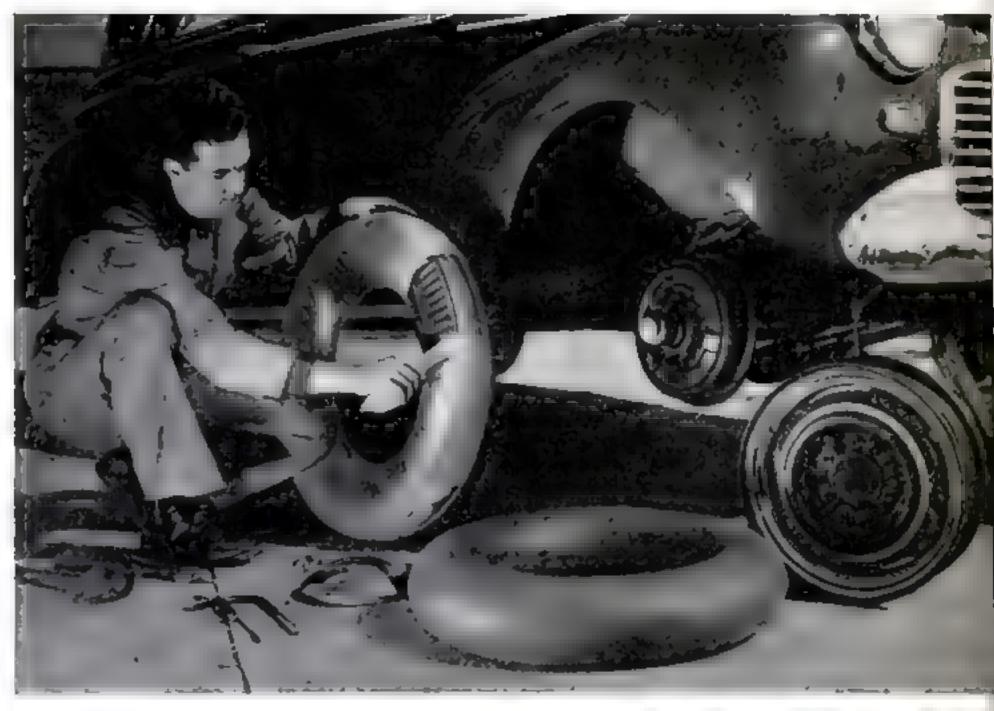
and gas-station attendants are helpful



Shift your tires occasionally from wheel to wheel for even wear, and include your spare in the program. Wheel alignment is important to tire life, and should be checked often







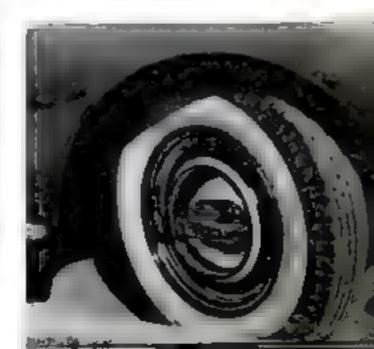
Keep tabs on a new tire, or one just repaired. It may lose several pounds in the first few minutes after it is fully inflated

STRETCH OUT YOUR TIRE LIFE

- 1 DON'T let tire pressure fall below the maker's recommendations.
- 2 A NEW tire, or one that has just been repaired, may lose pressure soon after inflation. Check it after a few miles.
- 3 DON'T run a tire constantly on the same wheel. Shift your tires from wheel to wheel for even wear, Include your spare.
- 4 DON'T rely on the theory that it is all right to run old tires on back wheels. A rear-tire blow-out can be fatal.
- 5 DON'T go around corners at high speeds, it wears tires faster than anything else.
- 6 EXCEPT to prevent an accident, don't slam on the brakes. The most gradual braking possible is best for tires.
- 7 HAVE your wheel alignment checked accasionally, rear as well as front.
- 8 LOOK over your tires often for stones, nails, cuts, and bruises.
- 9 DON'T drive too fast on hat, dry roads. Extreme heat hastens deterioration.
- 10 START up gently. Don't spin your wheels by gunning the motor in low or second.
- 11 DON'T bump into curbs or run over them. Tires have not yet been perfected that can stand this kind of abuse.
- 12 IF YOUR car begins to steer queerly, slow down, pull off the road, and inspect all four tires carefully. The action often means a tire is preparing to blow out.



Sharp stones, nails, tacks, and other objects should be removed promptly before they cause damage. Never drive a tire against or over the curb



GUS Tackles a Tough One

HE big, well-turned-out man who had driven a speckless sedan into the shop of the Model Garage got out of it and came over to the workbench with a wide smile on his large face.

"You're Gus Wilson," he stated positively to the Model Garage proprietor. "My name's Magruder—Willis J. Magruder. Glad to

meet you!"

"I'm glad to meet you," Gus said, wondering what he was selling. "What can I—?"

Magruder's hand gripped Gus's powerfully and he went right on talking. "I'm a nut on champions," he said. "I collect them just like some folks collect postage stamps. Name the top man in any line, and it's dollars to doughnuts I know him. Why, say, once I drove all the way down to Kentucky and back just to have a look at Man-O'-War! I couldn't shake hands with him"—Magruder laughed heartily—"but I've shaken hands with 'most all the other champs. Joe Louis, Bill Knudsen, George M. Cohan, Jim Farley, Clark Gable, John J. Pershing, Joe DiMaggio, Doc Einstein—I know 'em all. Yes, sir, top-liners are my hobby!"

"That's an interesting hobby," Gus admitted, wondering what was coming next.

Magruder shook hands again. "I've heard all about you from my friend Doc Marvin," he went on. "He says you're a champion—the top trouble shooter of the automotive business—that you ought to be the head

"Let's take a little ride," Gus suggested, "You drive and I'll listen," Magruder climbed in behind the wheel







"There's a devil of a noise in this bus when you put the brakes on, but it wasn't where I thought it was," said Gus

For withholding facts about his car, a new customer at the Model Garage — expecting miracles—will get a severe shock instead when he sees his labor bill

man in some big organization down in the city instead of running this—this—" His voice trailed off as he tried to find a word to describe the well equipped but small shop

Gus laughed. "The Model Garage suits me swell," he said. "I've worked for several of those big organizations you speak of, and I like this job here a whole lot better. But is there anything that I can—?"

"Yes, there is," Magruder assured him. "I didn't come in here just to waste a busy man's time. Doc Marvin says that the way you take a quick look at a car and tell just what's the matter with it is worth seeing—that it smacks of black magic. Well, just take a look at my bus, will you, and tell me what's the matter with it? It's driving me nuts'"

"Doc Marvin's put i..e on a spot," Gus objected. "I don't deal in magic, black or white. I've been in this game for a long time, and sometimes what I've learned in it makes it possible for me to cut corners and guess the right answer. But on most of my jobs I have to check and recheck and sweat and cuss, just as every service man does. Don't expect any miracles from me, Mr. Magruder. But I guess maybe I can find out what's the matter with your car, and fix it. How has it been acting up?"

"It's an almost new car," the big man told him. "There's less than four thousand miles on the speedometer. But every time I put the brakes on suddenly there's a loud, grinding noise that's got me worried."

"Let's take a little ride," Gus suggested.
"You drive, and I'll listen."

Magruder drove out of the shop and down the highway. When he got his car up to thirty-five he pressed his foot down on the brake pedal. The brakes took hold smoothly enough, but the grinding noise was very noticeable. "Hear it?" he demanded. But there was no need to ask.

"I sure did," Gus said.
"Sounded as if a chip
from the gears was being

ground between the differential gear teeth. If you'll drive back slowly—don't use your brakes any more than you have to—I'll have a look."

Back in the shop, he got out a grease pump, removed the plug from the differential housing, and began drawing out the lubricant from the housing. He forced out each pumpful on a screen placed over a bucket. When he had finished, he carefully examined the screen.

"What's the mosquito netting for?" Magruder wanted to know.

"To catch any little thing like a chip off a gear tooth in the oil that shouldn't be in it," Gus told him. But when the draining was completed, there wasn't anything on the screen

Then Gus really went to town. First he dismantled the rear-axle housing and flushed the assembly thoroughly with kerosene. Then he checked it carefully. No gears were chipped, and he couldn't find fragments from any other broken part. The faces of the gear teeth were polished brightly at the point of contact. "No smoke!" he said. "No gears are riding, and none are bottoming—and the backlash and end-play clearances seem just right."

"That doesn't mean a thing to me, not a thing," Magruder confessed, "I must have been hiding behind the door when they passed out mechanical ability. What d'you mean—that the trouble isn't what you thought it was?"

"It isn't what I thought it might be," Gus said. "I warned you not to expect miracles from me. This looks like one of those jobs I have to check and double-check and sweat and cuss over. The chances are it will be some time before I find out what's wrong, and then it may take me a couple of hours to fix it. You're welcome to wait if you want to, but probably it will save you a

lot of time if you call up late this afternoon or tomorrow morning in-

By MARTIN BUNN

stead. By that time I should be able to tell you what the trouble is, and about how much it will cost you to have it fixed."

Magruder thought for a moment. "I guess you're right," he said. "I've got to be down in the city this afternoon and evening. I'll phone you about ten o'clock in the morning. But don't wait for my call to fix up whatever's wrong. Get started on the job as soon as you can find the trouble."

After the new customer had driven away in a taxicab. Gus fired up his pipe, perched himself on the end of the workbench, and stared at the Magruder sedan as he did a job of serious thinking. Before he had finished it. Harry, the Model Garage grease monkey-who has grown into a pretty good sort of mechanic in his own right — came in. He watched his thoughtfully silent boss for a

few minutes, and then he asked: "Stuck?"

Gus grinned at him. "Stuck tight," he admitted. "There's the devil of a noise in this bus whenever you put the brakes on hard. Sounded to me as if it was in the differential, but it wasn't where I thought it was. So what?"

"Brakes, maybe?" Harry suggested. "Rear-wheel bearings?"

"Give me a hand," Gus said, "and we'll find out."

They took off the rear wheels, and Gus examined them carefully. The wheels weren't bent, the tires gave no indication of uneven wear, the bearings seated properly on the axle, and the axle keys were tight.

Gus grunted, and started checking the brakes. The contact surfaces of both the drums and the brake linings were as good as they had been the day the car had come off the assembly line. The brake shoes also were good as new, and the anchors were tight.

Harry wiped sweat off his forehead with the back of a greasy hand. "Nothing there," he said.

"It's somewhere, that's sure!" Gus growled. "I'll take another look at that differential."

They uncoupled the drive shaft and this time took the differential assembly completely out of the car. Gus examined it, and gave special attention to the universal-joint needle bearings, but they showed no wear, and were well lubricated. "By gum," he said. "I'll find the cause of that grind if we have to tear down the whole differential gear assembly."

They tore it down, but they didn't find the cause of the noise. Then Gus reassembled it in a vise on his workbench, and found that it ran smoothly both forward and backward. They cleaned the rear-axle housing, reassembled it, and filled it with lubricant. It ran sweetly when they put it on jacks.

Gus tipped the peak of his cap over his left eye and scratched his right car—a sure

sign that he was buffaloed.

GUS SAYS:

I recently read where one of the

engineers from a big outo company

declared that thirteen percent of

your engine power is lost if your

tires are six pounds underinflated.

At ten pounds under, almost one

quarter is wasted. That's something

for drivers to think about!

"Maybe we fixed whatever was wrong without knowing it—
I've had that happen to me more than once or twice."

When the car was removed from the lift, he took it out for a road test. Within ten minutes he was back.

"How was it?"
Harry demanded,

"Just the same as it was before I fixed it," Gus grumbled. "Maybe it's in the trans-

mission. Or maybe in the clutch. We'll have to-"

"Wait a minute!" Harry interrupted. "Don't you ever look at the clock?"

Gus looked at the shop clock, It was after six. "I'm sorry," he said. "You go ahead home."

"What are you going to do?" Harry wanted to know.

"I'm going down to the Park House and get my dinner," Gus told him. "Then I'm coming back here and lick that job if it takes me half the night. If I don't, I won't be able to sleep for thinking about it."

"I'll stick with you," Harry offered, "I wouldn't walk out on the old master while he's in the middle of a dither!"

"I'll dither you!" Gus said. "Come on—get washed up and we'll eat."

"Well, now, we've got to hunt," Gus observed when they got back from dinner. "The brakes, wheels, and differential are all right, so the noise can't be coming from the rear end, even if it sounds as if it is. Let's have a look at the transmission."

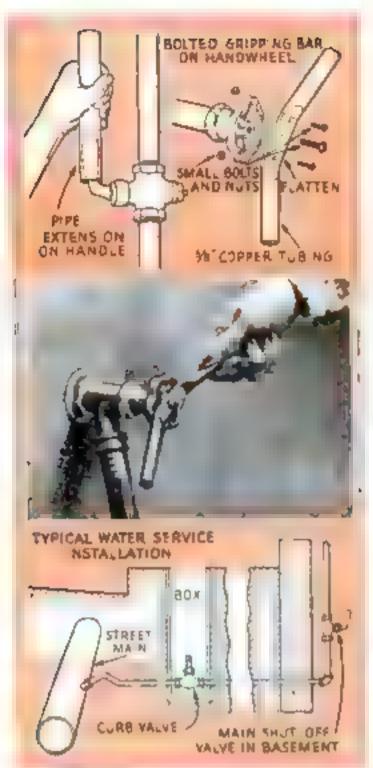
They dropped the drive shaft and removed the transmission, disassembled it, and examined it carefully. Not a gear tooth was broken or even so much as worn. Neither were any of the bearings. No loose nut was fouling the gears.

"Transmission's O.K.," Gus decided. "This is getting interesting. We'll have to check the clutch. Sometimes a projecting rivet, or a poorly fitting thrust ring makes a grinding noise. (Continued on page \$24)

HOME and WORKSHOP

MASTERING HOME PLUMBING REPAIRS
JOGGLING BOARD BUILDING SECRETS
HOW TO USE YOUR CAMERA ON A WALK



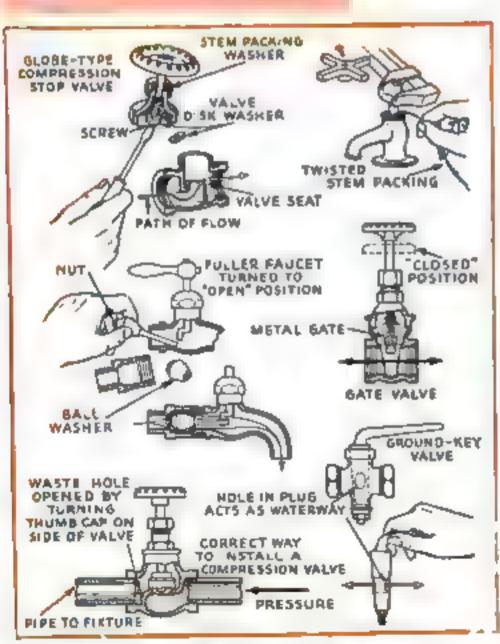


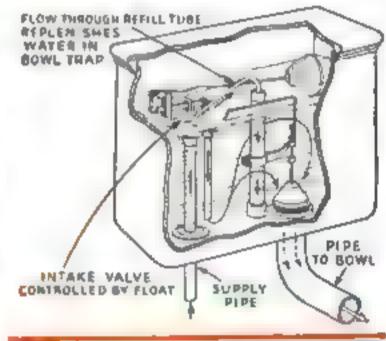
HOME PLUMBING REPAIRS

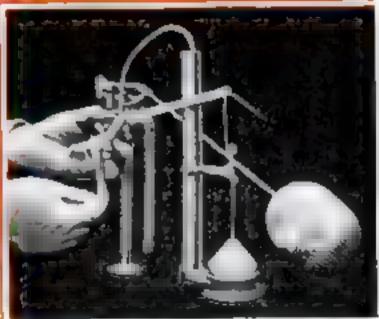
By JOHN MODROCH

and repair of the plumbing system will save the home owner many dollars.

To prevent damage in the event of a serious water leak, it is advisable that the entire household be familiar with the location of every shut-off valve. A cost of white paint applied to the valves will make them easy to recognize. Black letters indentifying each one according to the fixture it controls may also be added, although paper tags will serve the same purpose. It is also a good idea to label the main shut-off valve still more prominently, as by painting







If the average flush tank were of glass, this is how the valve mechanism would look

a short section of the piping leading to and from it.

established to a familiar that the world

Difficulty in closing a valve in an emergency can be prevented by putting an extension arm on the handle or by bolting a gripping bar across the handwheel. If there is no main shut-off valve in the house, the location of the curb, or street, valve should be known and the valve box kept accessible.

If, when closed, a valve fails to stop the flow of water, the trouble can usually be remedled by replacing its washer. There are two commonly used types of valves and faucets that have replaceable washers, as noted in the drawings. Fiber washers will stand up under use in both cold- and hot-water lines. Soft rubber washers should be used only in cold-water valves. Be sure, after replacing the washer, to turn the binding screw down tight; a loose washer tends to vibrate noisily.

The other types of valves shown

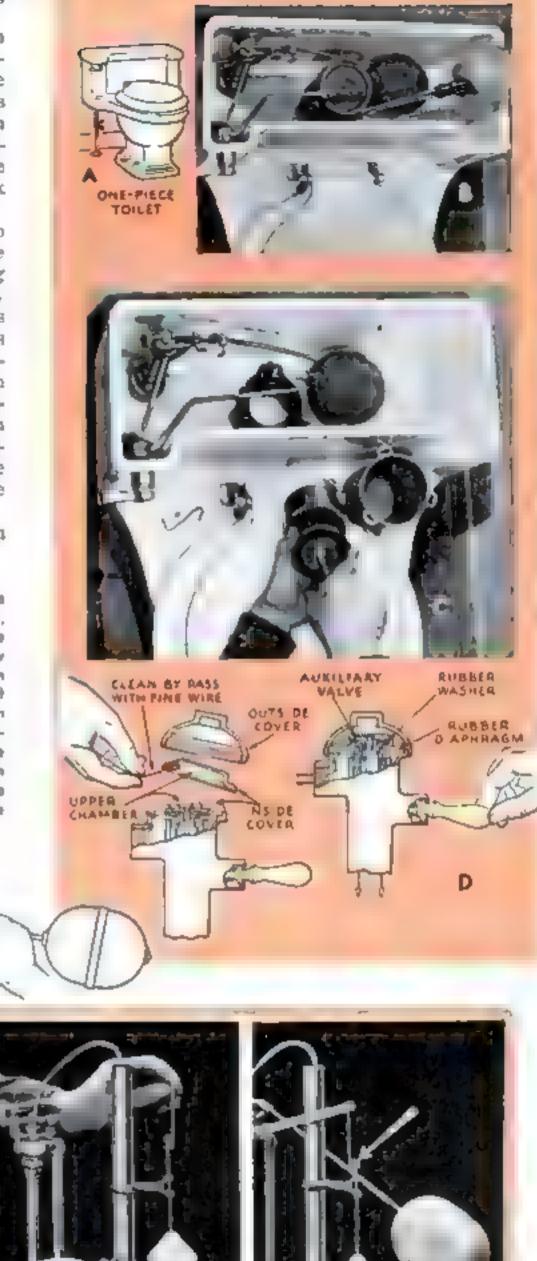
A one-piece toilet like that shown at A hos a large rubber disk washer. To replace it, take off the valve shell by loosening the retaining acrews as shown at 8; then unscrew the metal disk that clamps the washer in the cup as at C. The type of volve shown at D operates as follows: The handle tilte an auxiliary valve, releasing pressure in the upper chamber. Pipe-line pressure lifts the diaphragm, allowing water to flow through valve. Meanwhile, water flowing through a by-pass fills upper chamber and closes valve

> BENDING FLOAT ROD TO TAKE UP SLACK

SLOT FOR LIFT ROD

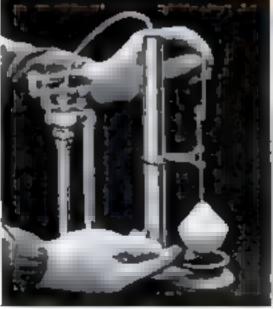
GROOVE FOR SPLIT LEATHER STUFFING WASHER

RUBBER D SK VALVE WASHER RETAINING RING

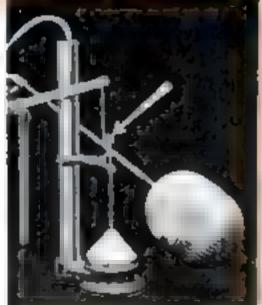




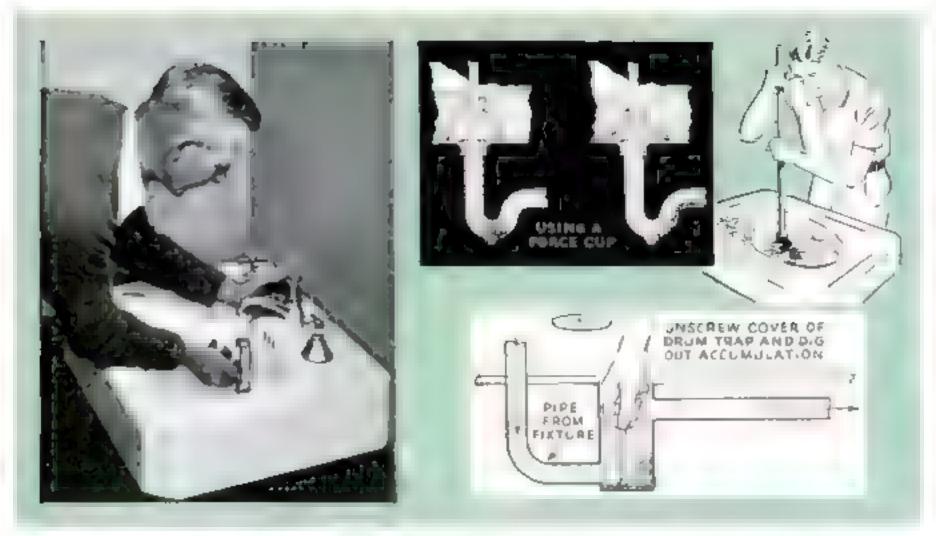
To replace the intake-valve washer, the valve plunger must be removed



Substituting a new, springy rubber valve ball at autlet



Allow ample play at the point marked by the arrow



Pap-up lavatory stopper tubes should frequently be lifted out and cleaned. Obstructions in ordinary traps can usually be removed with a force cup. Where drum traps are used, dig out the accumulation

have no washers, but the metal-to-metal contact of accurately machined parts scals the waterway. When these valves fail, replace them with new ones.

If a valve leaks around the stem, a slight turn on the packing nut may stop it. If not, remove the nut and replace the rubber washer or wicking with fresh packing. Ordinary cotton string rubbed with soap and twisted double can be wound tightly around the stem to serve as packing for cold-water valves. For hot-water valves, an asbestos or a graphite packing should be used.

The automatic controls most likely to get out of order as a result of wear and neglect are those located in the flush tank of the toilet. The result is either an erratic flushing action or a constant running of water down the overflow tube. To remedy this, bend the float rod to make allowance for the slack.

When the parts become corroded to the point where proper adjustment of the action is impossible, they should be replaced with new ones. If the metal ball float has shipped water as a result of a leak, it also will foul the valve action. This trouble can be corrected by soldering up the hole or by installing a new float ball.

Providing its metal parts are in good condition, a leaking intake valve in the flush can be fixed merely by replacing its washer or washers, as the case may be. To do so, first shut off the water supply, then disconnect the float mechanism and lift out the valve plunger. Take out the rubber valve

washer by unscrewing the retaining ring from the end of the plunger. Remove the leather stuffing washer, if there is one, by lifting it out with your finger nail.

If the washers prove to be in good shape, the leak may have been caused by chips of pipe scale lodged between the plunger and the valve scat. In this case, thoroughly clean out the valve housing before replacing the plunger.

The outlet valve at the bottom of the tank is another common source of trouble. In one type of tank, this consists of a rubber ball that is pressed down against the rim of the valve by the weight of the water when the tank is full, thus scaling the opening. With age, this ball hardens or swells out of shape and must be replaced. One good grade of mushroom-type replacement ball is sold in a sealed can to preserve its liveliness. It will prove convenient, therefore, to keep an extra one on hand. In order to seat properly, a rubber flush ball must hang in perfect alignment with the rim of the valve. Adjustment of the guide arm, if required, can be made after loosening the two screws that clamp it on the overflow tube,

If the overflow tube springs a leak around the threads at its base, unscrew it from the outlet valve housing and install a new one. A leak at this point will be indicated by the constant running of water into the bowl.

A large rubber disk washer, instead of a rubber ball, is used to close the outlet valve of the one-piece toilet illustrated. When worn, this washer can readily be removed for replacement by first taking off the shell

that covers the float. Then remove the metal disk that clamps the washer in the cup by turning out the binding screw.

Toilet flush valves, commonly used instead of flush tanks in apartments and other large buildings, will let water run continuously if the by-pass is stopped up or if an accumulation of sediment prevents the auxiliary valve from seating. In a valve of this type, the by-pass and auxiliary valve seat can usually be reached for cleaning by unscrewing the outside cover. A spanner wrench, or similar tool, however, may be beeded for unscrewing the retaining disk that holds down the rubber auxiliary washer and main diaphragm, both of which are replaceable.

If waste water drains slowly from a fixture and gurgles while going down, it is a sign the drain is clogged. A rubber force cup, such as the one shown, will usually open up a sink or closet drain that is only slightly clogged. An obstinate stoppage, though, will require the use of a length of spring cable or a coil-spring auger.

Solids and hardened grease deposited in a U- or B-shaped trap can be removed by unscrewing the plug at the bottom. Sediment must be dug out of a drum-type trap after acrewing off the cover. The removable stopper tube of a lavatory equipped with a pop-up waste frequently gets clogged, so it should be lifted out and cleaned regularly.

When using a toilet-bowl coil-spring auger for removing stoppages in the trap, the technique employed should suit the nature of the obstruction. Rags, for example, must be worked out slowly, while hard ob-

jects call for a quick back-and-forth action of the snake to jump them back through the passages.

Prepared chemicals sold expressly for cleaning toilet traps are labeled with explicit instructions for their use. These should be followed carefully to avoid possible damage to the plumbing. Certain chemicals should not be used at all in drains. Caustic soda, for example, forms an almost insoluble hard soap upon coming in contact with grease.

Unnecessary damage to the connections is often caused by home owners who try to take up the toilet bowl without first disconnecting the flush tank. If the flush tank is removed first, the spud collar-nut on the outside of the bowl need not be touched at all. It is usually necessary only to unscrew the slip joint at the tank end of the elbow, leaving the other end connected to the bowl. The tank can then be unscrewed and lifted off the wall, allowing the bowl to be unbolted and lifted off the drain connection on the floor.

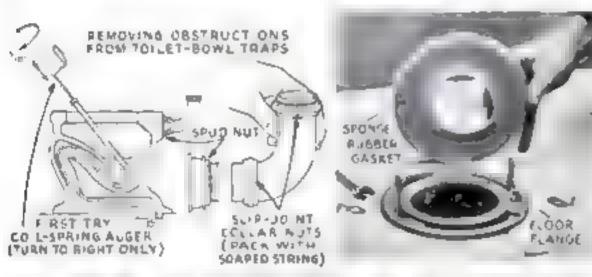
Before removing the fixtures, it is necessary, of course, to shut off the water supply, drain the tank, disconnect the supply pipe, and also bail out the water remaining in the bowl trap. With the bowl laid on its side, access to the clogged passage of the trap can be gained easily through the bottom.

A new sponge-rubber floor-flange gasket or several pounds of putty should be on hand for use as joint packing when resetting the toilet bowl. If putty is used, turn the bowl upside down and lay a mound of it around the outlet opening. Then turn the

bowl right side up and reset it.

Should a stoppage of a drain occur at a point beyond the trap of the fixture, run a length of apringy cable, such as a piano wire, down through the soil pipe. For this purpose, plumbers carry a special soil-pipe auger. Access to the soil pipe running out under the house can be had by removing the piug of the cleanout tee usually located in the basement.

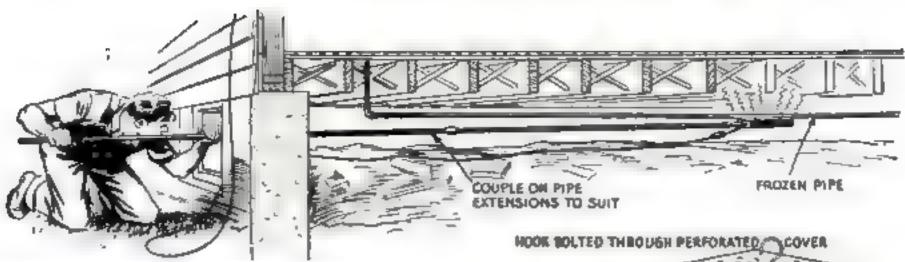
A common practice for preventing unprotected pipes from freezing up solidly is to let the faucets run in a fine but continuous stream of water. A pressure relief valve inserted in an exposed line will also afford the piping some protection by relieving the pressure













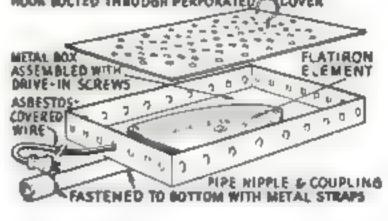
REEP COVER IN OIL CAN

DISCONNECT ADJOIN, NG
FITTINGS

FAOZEN
UNDERGROUND PIPE

Hard-to-reach water pipes can be thawed with steam fed through a subber tube

Another method is to set up copper tubing or small pipe so that boiling water can be poured into the frezen pipe



exerted by the formation of solid ice.

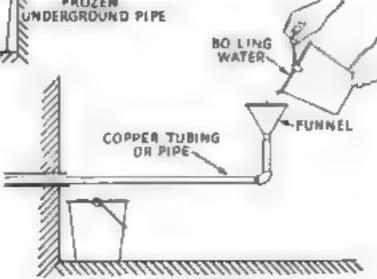
When plumbing is not in use, the surest way of preventing it from freezing is to shut off the water and drain the system. To do this, open the drain fitting located at the lowest point in the system and also all faucets so as to relieve the vacuum in the lines. Water must be drained from the toilet, flush tank, the water-heating system, and all traps, including the toilet bowl. Traps may then be filled with a non-freezing liquid, such as kerosene or radiator antifreeze, to maintain the seal against rewer gases.

A frozen water pipe should be thawed systematically by beginning at the faucet, or outlet end, and working back toward the main supply line. Open the faucet to permit the water from the melting ice to drain out, and turn on the main valve to allow the line pressure to help break up the ice.

Where there is no danger of burning nearby woodwork, exposed piping can be thawed quickly by applying the flame

of a blowtorch. Take care, however, to spread the heat evenly by playing the flame back and forth constantly along the pipe. Where danger of fire exists, hot bricks, electric heaters, and boiling water poured over a wrapping of cloths can be used.

The homemade electric thawing de-



vice illustrated, costing less than fifty cents to build, permits frozen pipes under buildings and in other hard-to-reach places to be thawed with safety. It consists of a flat-iron element housed in a protective perforated metal box.

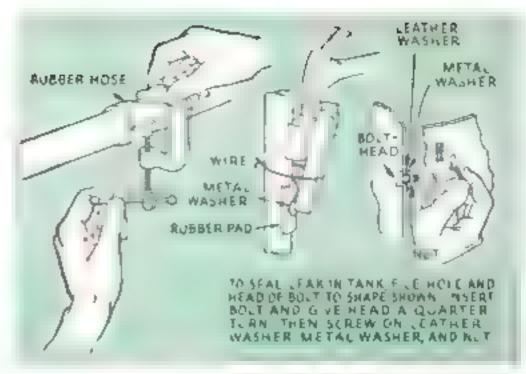
When thawing pipes concealed under floors, in partitions, and under the ground, the work must be carried on from one end, as illustrated. Steam generated by boiling water in an oil can, to which a suitable length of rubber hose is attached, can be used effectively for doing the job. The tubing should be fed into the pipe as fast as the ice melts, so as to keep the steam in contact with the unmelted por-

tion. To avoid any possible danger that the can will blow up from excess steam pressure, be sure to keep the cover unscrewed and merely laid over the cover hole.

Boiling water may be used in a similar manner. It should be poured into a funne. attached to the end of the tubing. When thawing a long run of pipe, however, it will be found more practical to substitute copper tubing or small size pipe for the rubber tubing.

When time is an important factor, the electric pipe-thawing method—a service often offered by electric welding companies—is probably the most expedient one to use on long underground water lines.

If the formation of ice in a frozen pipe has caused a break, emergency pipe-leak repairs can be made by the home owner with whatever common materials he has on



Two ways to stop a pipe leak and method of repairing tanks

hand. Iron cement and friction tape, a short piece of hose and a C-clamp, a pad of rubber and an improvised wedge are some typical examples. The trick of using a leather washer and a stove bolt for making a temporary repair of a leak in a storage tank is also shown.

If an extremely slow leak at a pipe joint is caused by continual vibration or movement of the pipes, it can usually be stopped by making the joint rigid with cleats and straps. Stopping the movement at the joint gives the dope on the threads a chance to coagulate, thus sealing the leak.

Cold-water pipes in basements and in rooms lacking good air circulation are likely to "sweat" on humid days in the summer time. Providing adequate ventilation or incasing the pipes in a scaled air-cell covering are the alternate remedies.

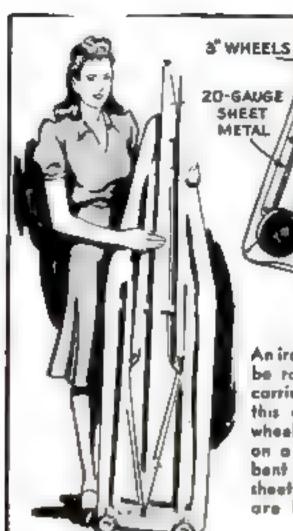
PROTECTIVE HAND CREAM

[FORMULAS]

A mixture of lanolin and castor oil is frequently used on the hands and arms of machinists susceptible to skin trouble caused by constant contact with lubricating oil. This type of "extra skin," however, is not so suitable for those doing general work about the shop, garage, or home.

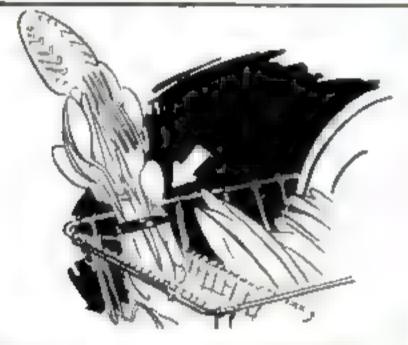
A good protective cream for all-around use can be made from one part by volume of gum arabic, placed in a wide-mouthed, covered container. Add only enough water to cover the drops of gum and allow to stand overnight; then stir in two parts (or more, if desired) of ordinary soap chips. This cream is applied to the hands and well rubbed in before beginning work. Afterwards it is easily washed off, along with all the dirt.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



HEELS SHEET METAL

An ironing board can be rolled instead of carried by installing this device. Two 3" wheels are mounted on a frame cut and bent from 20-gauge sheet metal. The asles are long "4" bolts



Silverwore can be dried without wiping if held tagether with a heavy rubber band, rinsed in hot water, and then stood upright in a wire drainer



When filling your fancy salt and pepper shakers, use callulose tape instead of carks to seal them

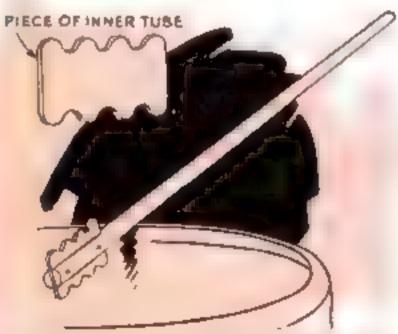
THE ELLING



A piece of rubber splicing tape wrapped around the end of a screw driver forms a tube to hold a screw while inserting it in an awkward place

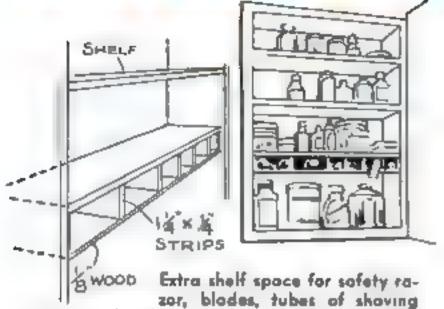


If the shoeharn has been mislaid, a handkerchief may be used. Place a corner in the heel of the shoe and pull as the foot is forced down



Handkerchiefs and similar articles can easily be fished from the wash bailer or laundry tub if rubber fins are added to the stirring rad

THE HOME SHIPSHAPE



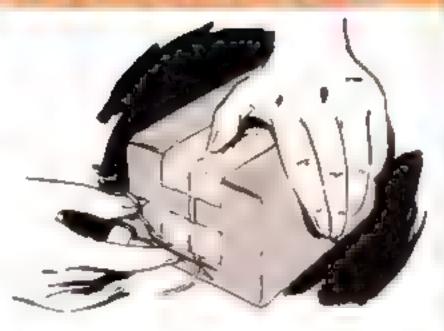
zor, blades, tubes of shaving eream and tooth paste, and similar items can be added to many wooden medicine cabinets



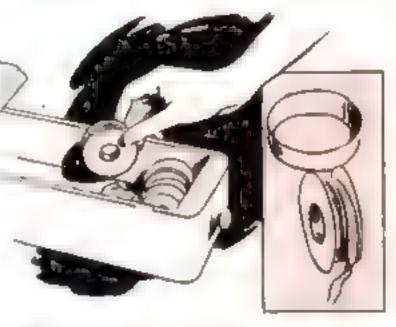


If the lower window sosh sticks, pull out

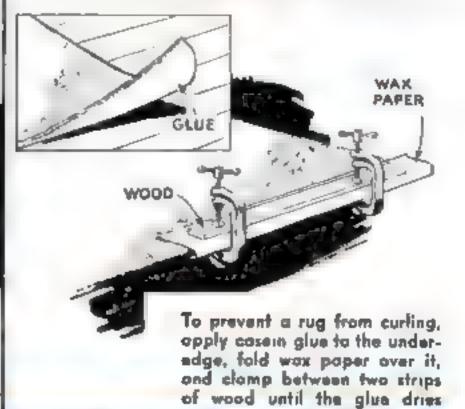
the two sosh cords and let them snap back



Placing cord under the tape of a sealed package makes it easier for the recipient to open it. For the low postage rate, an opening-permit label must be attached



Wind odd pieces of lace, braid, and electic around empty adhesive-tape containers so they can be stored neatly in drawers



WHAT DEFECTS TO LOOK FOR

A Room-by-Room Check List for Home Owners

		Hall P	No.	trag	Burre	Seirpeti No. 1	Sed som No Z	in i	Lithia	Bath 1	Bath Bo Z .	Derd or Pinich	Med s	Base mens
FLOORS	Squeaking Shaking Cracks Baseboard cracks													
CONCRETE	Worn Anish Dusting Cracked Rough Worn													
	Dull Torn							Ш						
WALLS PLASTER	Crocked	i												
WALL PAPER	Storned Warped Open joints Old	i												
CEILINGS														
PLASTER	Crocked Sleined Loose													
WINDOWS	Water leaks													
47000	Air feeks Loose Tight Faling paint Poor outly													
METAL	Broken cotchet Warped Water leaks Air teaks Warn hardware													
DOORS														
INSIDE	Sticking Loose Worned Worn hardware													1
OUTSIDE	Air leaks Water leaks Foor fil Ware hardware													
TRIM								_						
THE WAR	Open oints				ш									
TILE WORK	Loose O sco gred													
WIRING	Cords frayed Fistures shabby													

FOR SPECIAL ATTENTION: STAIRS, HEATING, AND PLUMBING

5	ī	A	ŧ	Ř	\$
		-			

- Squeaking Wook handtailt
- Poor I um nat on

REATING

- Paor distribut on
- Drofts
- Cold areas near windows Cold exposed rooms
- High fuel consymption Cold Room and walls

CHIMNET DRAFT

- Small no heater
- Smoking fileplace Pour diath in heater
- Draft control neffective

STEAM-HEAT SYSTEM

- Rad plar not heating No sy pipes Slow heating

Water leve draps

Noise n boiler

HOT WATER SYSTEM

- Uneven distribution
- Cold rad afor

HOT AIR SYSTEM

- Uneven distribution
- Dust

HEAT LOSS

- High fuel consumption. Overheated ceilar
- Last of m adoms
- Lass through certings and walls

PLUMBING

- Clogged water pipes
- Cropged drain pines
- Clagged cassoool

Suptre tonk not working

Noisy piping

HOT WATER SUPPLY

- Insuffic ent hat water from pot slove, indirect heater,
- firebox coil, or gas ar o I healer Water rusty and dirty Noise in supply tank
- Voriable flow

- Leaking flush-fank valves
- Leaking foucet wothers
- Dull finish of exposed piping

- Leaks in cell or walls and floor Cettor condensation
- Condensation on pipes and flush tanks
- Condensation on walls and certings.
 Condensation on window glass

Your House Needs a Check-Up

By ROGER B. WHITMAN

Home-building export and author of First Aid for the Ailing House

KNOW a home owner whose chief hobby is his house. He is so familiar with every little detail, inside and out, that he notices any change in it. This may be a new crack appearing between two floor boards . . . a drop of water forcing its way through window-pane putty . . . an unexpected noise in the plumbing or the oil burn-

er... the loosening of a roof shingle... the burning of more oil than the temperature warrants... a creak in the stair. To him, any one of these and many other things means added and unnecessary expense, or a beginning of deterioration that should be stopped before it leads to real trouble. As a hobby it is one of the most sensible, for not only is it a money-saver in maintenance, but it maintains the security of his investment.

Few owners are so well acquainted with their houses that they can recognize the beginnings of deterioration. They do not realize that some imperfection, apparently trifling, may develop into serious damage. Yet in the keeping up of a house, it is the little



Windows that stick are one of life's little annoyances. Too loose is even worse, because then they waste fuel

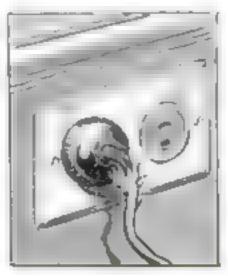
things that should be given attention; the beginning of a split in a clapboard may, if left alone, result in a water leak and the eventual rotting of an important timber. I have been shown through houses by proud owners whose eyes were so taken by surface decorations and effects that they were oblivious to cracks in the foundation walls and the dripping of corroded water pipes. One, I remember, explained the good points of his stoker, but was quite unmoved when I opened a door of the boiler and found that the flue passages were nearly clogged with fly ash and soot.

Home owners who have no deeper knowledge of their houses than surface finishes and decorative effects are the ones who com-









With the check list, you can discover all the faults of a house so they can be remedied one at a time

plain of the high cost of ownership. It is not that they do not want to know. The trouble lies in their never having had an opportunity to learn the construction of a house, the functions of the parts, the relation of one part to another, and the ways in which the parts are put together. If they eventually learn, it is usually through bitter experience.

The accompanying check list of the possible failures of the more important parts of a house is intended as a guide to home owners who are interested in overcoming deterioration and in keeping their houses in good condition. It contains only a few references to the finishes of floors, walls, and other surfaces, for these are obvious.

To make use of the check list, an owner should go over his house room by room and note the condition of each detail. This will enable him to set about the work of renovation systematically. He might complete all of the work in one room at a time, but will probably find it simpler to make one job of repairing all plaster cracks or adjusting all doors and all windows, or refinishing all floors.

An owner who is careful of his property will make a detailed examination once every month or two, taking a rainy Sunday morning for it, or some other time when he has



If you make regular inspections, you'll notice every slight change. A new stain under the roof may warn you in time to prevent a bad leak and costly repairs

nothing else on his mind. He can well begin in the attic, with a flash light to use in the dark corners. When he knows the appearance of the underside of the roof, for an example, a stain that was not there on his previous visit will catch his eye and start him hunting for the cause. Quite likely, it shows the beginning of a roof leak, which, when caught at so early a stage, can be prevented from developing into something serious and expensive.

Each room should be looked over—floor, walls, ceiling, windows, and every other part. After a few such studies the owner will be so well aware of the normal appearance of every section of the entire house that any change will be apparent, and will set him to learning the cause and the remedy. The check-up should not take more than an hour or so, and even if it takes a morning at first, it is not too much time to give to safeguarding so large an investment.

Knowledge of a house has other advantages. A suburban housewife, alone in the house one morning, was doing something in the kitchen when she was startled by the noise of water in the hall. Running out, she saw a cataract of water coming down the stairs from a burst pipe in the bathroom. Her husband had always taken care of the mechanical parts of the house, and while she

knew that there was a shut-off valve in the cellar, she had no idea where to find it. She ran to the front door, hoping to see someone who could help her, but there was nobody in sight. She did not know the name of the plumber, so finally, in desperation, she telephoned the police. It was a quarter hour or more before an officer came and turned off the water, and by that time, parts of the house were thoroughly soaked. In the end, a new floor had to be laid, a fallen ceiling replaced, and other damage repaired.

A friend of mine, who had just moved into a new house, heard the story and took steps to avoid such a tragedy. He tied a baggage tag to every valve, handle, switch, and other operating mechanism in his cellar, each with the proper label: "This shuts off all the water in the house": "This shuts off the hot water in the second-story bathroom"; "This abuts off the gas"; "This shuts off the electricity"; "This lets water into the boiler," and so on. Then he brought his wife, his two half-grown children, and the maid into the cellar. explained each tag, and made each member of the household experiment with turning things on and off.

JOGGLING BOARD

Carolina institution which is more fun than a couple of barrels of monkeys on a seesaw, is beginning to find its way to homes in other parts of the country. Visitors to Charleston and the plantations of the South Carolina low country see southern children and their elders joggling away in great glee and are immediately won over to this curious means of play and exercise Some have one made and shipped home. Others take the measurements and make one themselves.

Instead of having a standard in the middle like a seesaw, the joggling board has one at either end. These standards are sturdy, and on the bottom of each are a pair of rockers. Between the standards extends a pine board from 18' to 24' long.

There are a number of ways in which

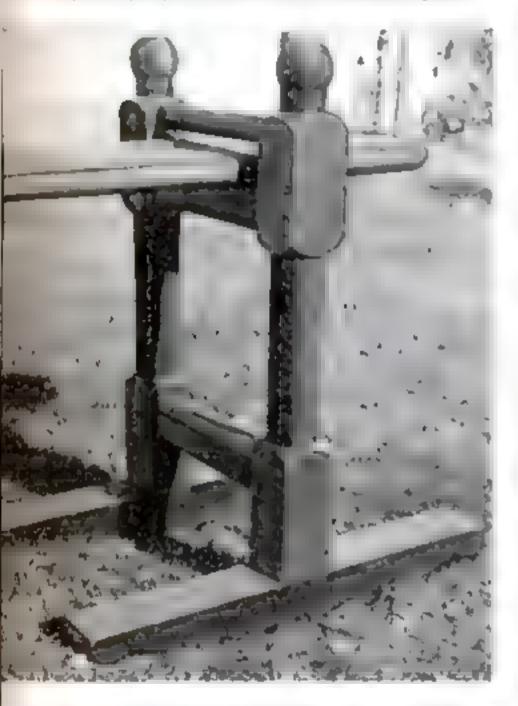


Popular in South Carolina for a hundred years, jaggling boards are now being copied in many parts of the country. When the board is set in motion, the jaggler's body follows an elliptical course. The board above is 18' long and is made of yellow pine





A tapered pin prevents the board from sliding out



Close-up of the standards and, below, the rockers



a joggling board may be used, and a wide variety of games may be played on it. The joggler sits in the middle of the board, which is about 2'6" above the ground. By posting, as when riding a horse, he starts the board in motion. Soon he is bouncing, or joggling, up and down briskly.

As the vertical motion of the board increases, the joggler begins to leave the board each time it rises. When this happens, he feels like a soaring bird on each ascent. By shifting his weight as he joggles up and down, he starts the joggling board swinging back and forth on its rockers. As a result of this, the joggler's body begins to follow an elliptical course.

It is more fun when two or more persons joggle at the same time. It is surprising how much weight a southern pine board can hold. Three, or even four persons, can joggle at the same time.

Children take to the joggling board immediately and invent all sorts of games to play. Sometimes two or three will stand up and joggle. The object of this game is to see who has to jump off the board first.

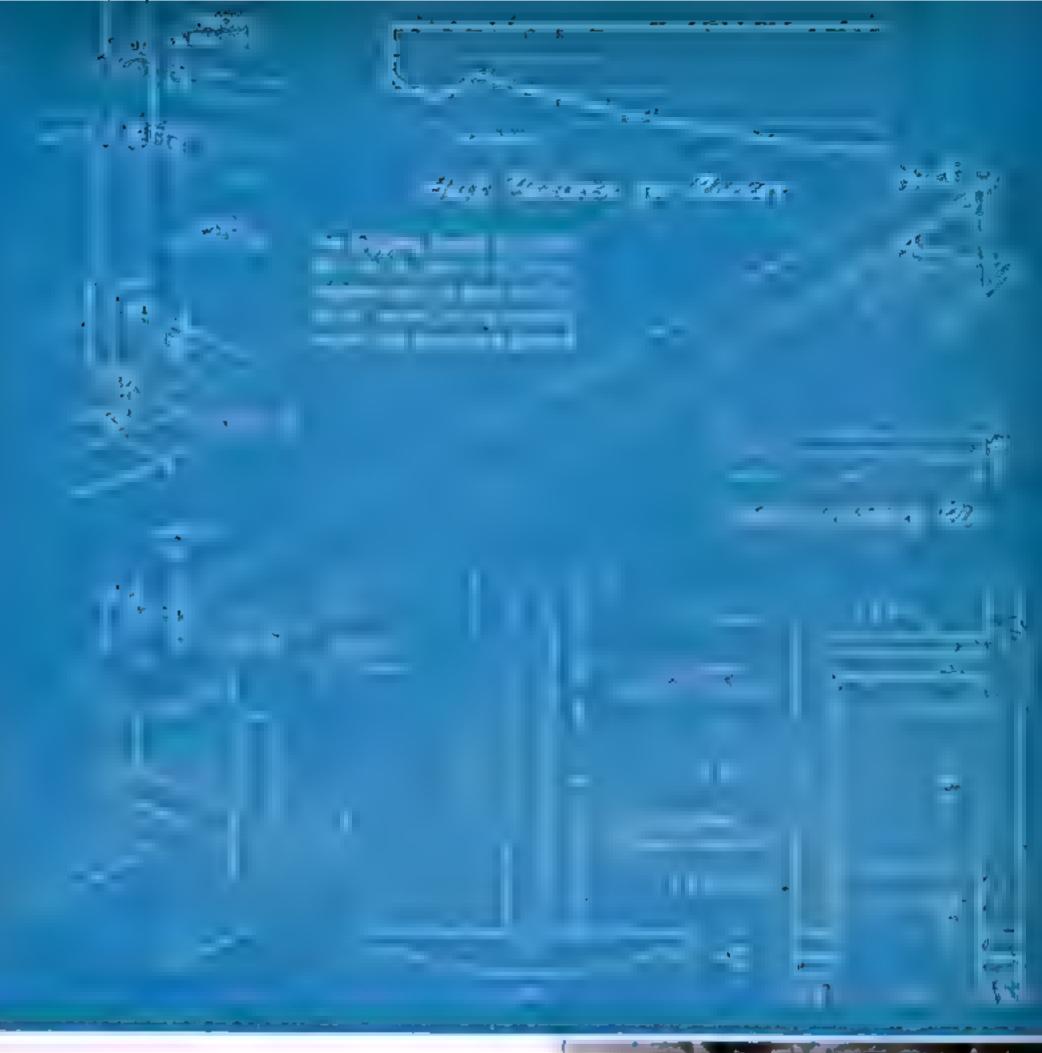
When set up on the lawn, the joggling board becomes not only a plaything for the children, but a bench where more sedate adults may sit and rest.

Joggling boards have been used in South Carolina for more than 100 years, and generations of children have played on them. They are to be seen on the verandas of old southern mansions in Charleston. They are to be found at many of the old plantations in the low country. Some of them have been used by families for seventy-five years or more and are still going strong.

Some of the joggling boards at the plantations are 22' or 24' long, and from many years of usage the boards are almost as springy as steel. In the old days the boards were made of southern long-leaf pine; nowadays they are made of yellow pine, which is almost as good.

As it is of simple construction, a joggling board may be assembled without difficulty by following the dimensions given in the accompanying drawings. Suitable lumber may be obtained at almost any lumberyard, but care should be taken in the selection of the board itself. This should be straight-grained and without knots, cracks, or other defects. The better the board used, the more weight it will carry and the more spring it will have. The board is usually 1% " thick, but if it is to be used only by children it may be 114" thick. It is better to have it planed to the greater thickness because, although you may intend it for the children, you will find that most of your adult visitors will want to try it.

If a lathe is available, the upright members used in making the end supports may be turned as shown; otherwise they may be left square except for rounding or chamfering the



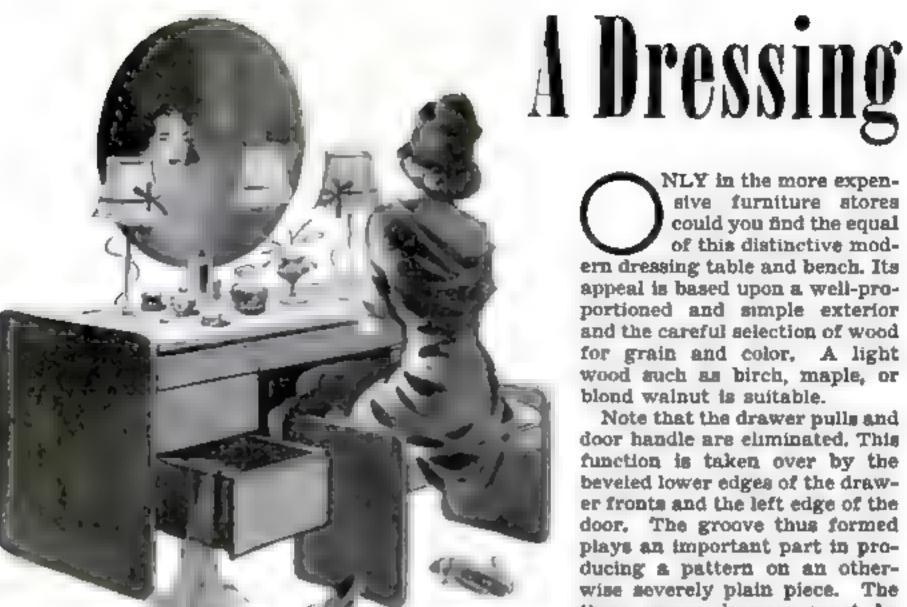
The board is 18' long in this case, but could be as long as 24'. Right, band-sawing one of the rockers

sharp corners. Sawing the rockers is no problem for anyone who owns or has access to a band saw. If necessary, however, draw a full-size pattern on paper and have the rockers cut out at a local mill or woodworking shop

It is well to give the completed board several coats of green or brown paint because this will keep it from checking

Owners of joggling boards find they soon become a popular source of amusement for friends and neighbors. There is one family which has a joggling board on the grounds of their country place in Pennsylvania, and their yard has become a gathering place for all the children in the vicinity.





NLY in the more expensive furniture stores could you find the equal of this distinctive modern dressing table and bench. Its appeal is based upon a well-proportioned and simple exterior and the careful selection of wood for grain and color. A light

blond walnut is suitable. Note that the drawer pulls and door handle are climinated. This

function is taken over by the beveled lower edges of the drawer fronts and the left edge of the door. The groove thus formed plays an important part in producing a pattern on an otherwise severely plain piece.

three upper drawers must be

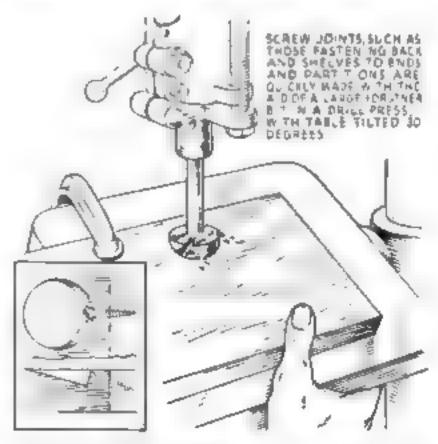
wood such as birch, maple, or

carefully fitted to preserve the groove line intact. A false groove is carried across the door, which is hung on invisible type hinges. The bevel on the upper edge of the drawers should be made after they are completely assembled.

The center drawer, not detailed, is similar to the others except that the front is flush with the sides at both ends. The front joints are the same as detailed at the left in the drawer that is shown in detail. Note the locking strip in the right-hand detail.

LIST	OF	MA	TER	IALS
	FOR	TABL	M g	
Description	n This	·lemana	3075-015	Tana

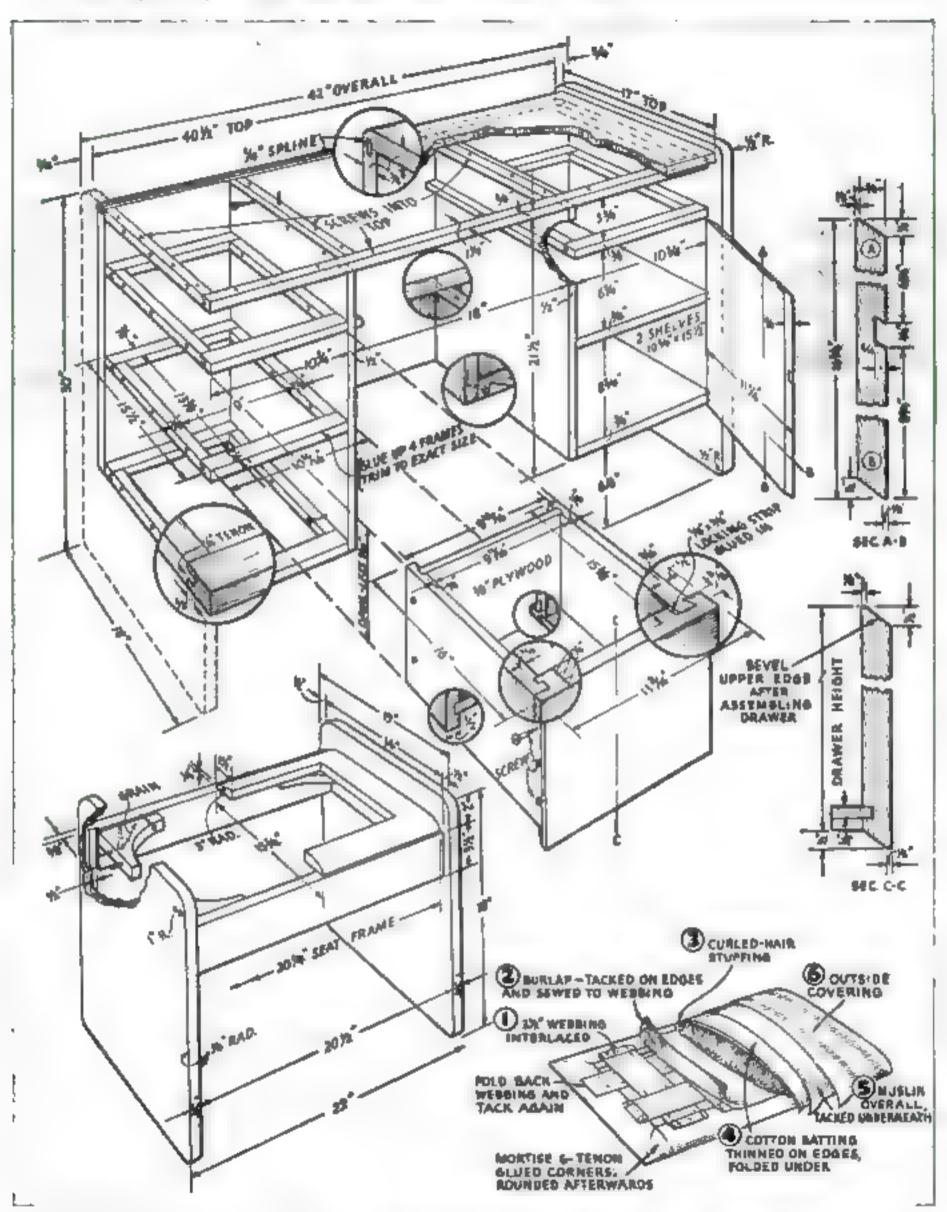
FOR	TABL	. II	
No. Pc. Description This	ckness	Width	Length
1 Top 2 Ends 1 Back 2 Vertical partitions 1 Door 2 Upper drawer	n, n, n, n, n, n, n, n, n, n, n, n, n, n	17 15 2214 10 x	40 9 30 40 9 22 1 16 %
front	%	4.56	11 3 16
front	34	434	17-15 16
1 Meddle drawer front	%	7 %	11 3 16
1 Lower drawer front 2 Lower drawer sides 3 Mature drawer sides 6 Upper and center	1.5 2.5 2.5	91, 8-11-46 6-11-16	11 3 16 15 % 15 %
drawer sides 2 l'pper drawer back 1 Center drawer back 1 M.ddledrawer back 1 Lower drawer back 4 Up., mid., low.	Ly ply	3-11 18 3 3 16 3 3 16 6 3 16 6 7 16	15% 9 15 16 17 3 16 9 15 16 9 15 16
dr bott, ms	1 ₄ ply	9-15 16	15 4
1 Center drawer hottom 2 Shelves 1 Top Fail 8 Intermed Fails—	of Div	17 3 16 15 2 14	1514 103, 40 a
frent and back S Side rails 4 Top cleats 2 Center drawer	or _a or _a	134	10% 14 1 8 14-5 8
181.6	NA.	36	15%
PHH	BENC	H	
2 6.de stretchers 4 Corner b ocks 2 Seat frame—sides	7-4 67-6 7-18	15 34 4 11 ₉ 13 ₈	19 21/4 17/4 13/4



MODERN STYLING - DISTINCTIVE DESIGN

Table and Bench donald A. PRICE

on an indicate a part of



SIMPLICITY OF CONSTRUCTION UTILITY

WORKBENCHES

O MATTER what kind of home workshop you have, there is really nothing more important in it than the workbench. You may have all sorts of machine tools, yet you still have to spend much of your time fitting and assembling at the bench.

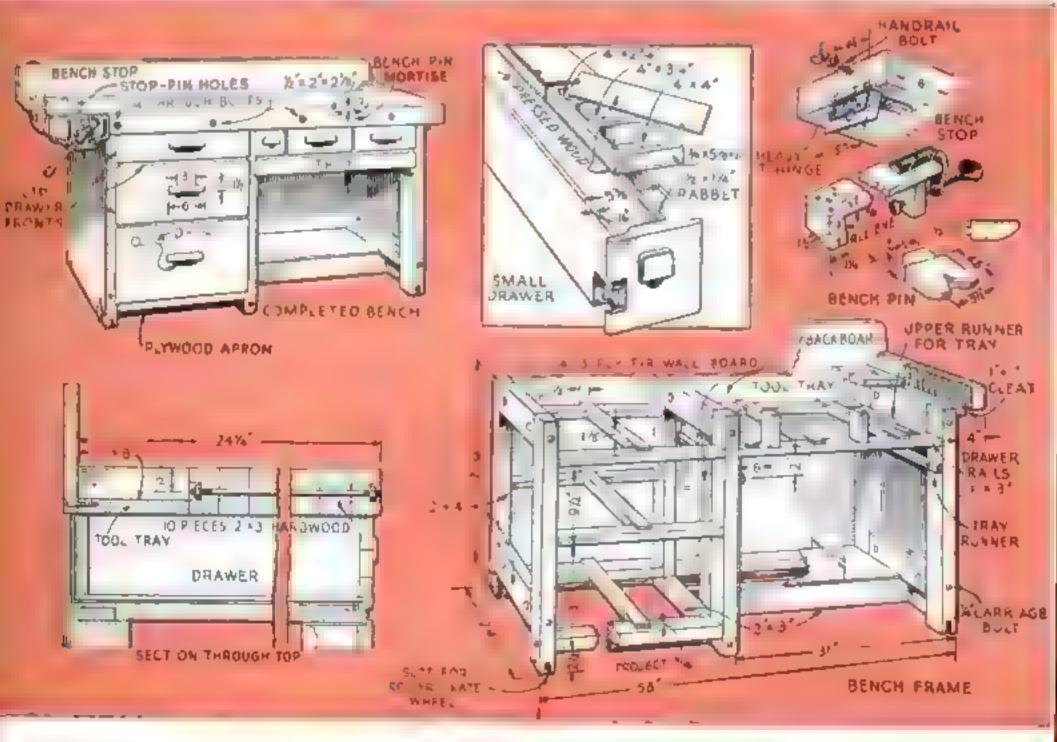
This month we present a new workbench designed especially for the POPULAR SCIENCE model home workshop. It differs somewhat from a standard cabinetmaker's bench, since it is adapted to such widely varying work as building garden furniture or intricate ship models. The most obvious change is the omission of a tail vise, but a special stop makes up for this and saves buying the extra unit.

The top is glued up from 2" by 3" hard-wood stock, preferably maple, although birch, oak, or even fir may be substituted. Such a top, carefully made, will last a life-time. It is often possible to buy good used material at a fraction of the cost of new stock. Four ¼" iron rods, threaded at both

ends and provided with nuts and washers, pass through the top from edge to edge. They should be cut long enough to project %" at each end.

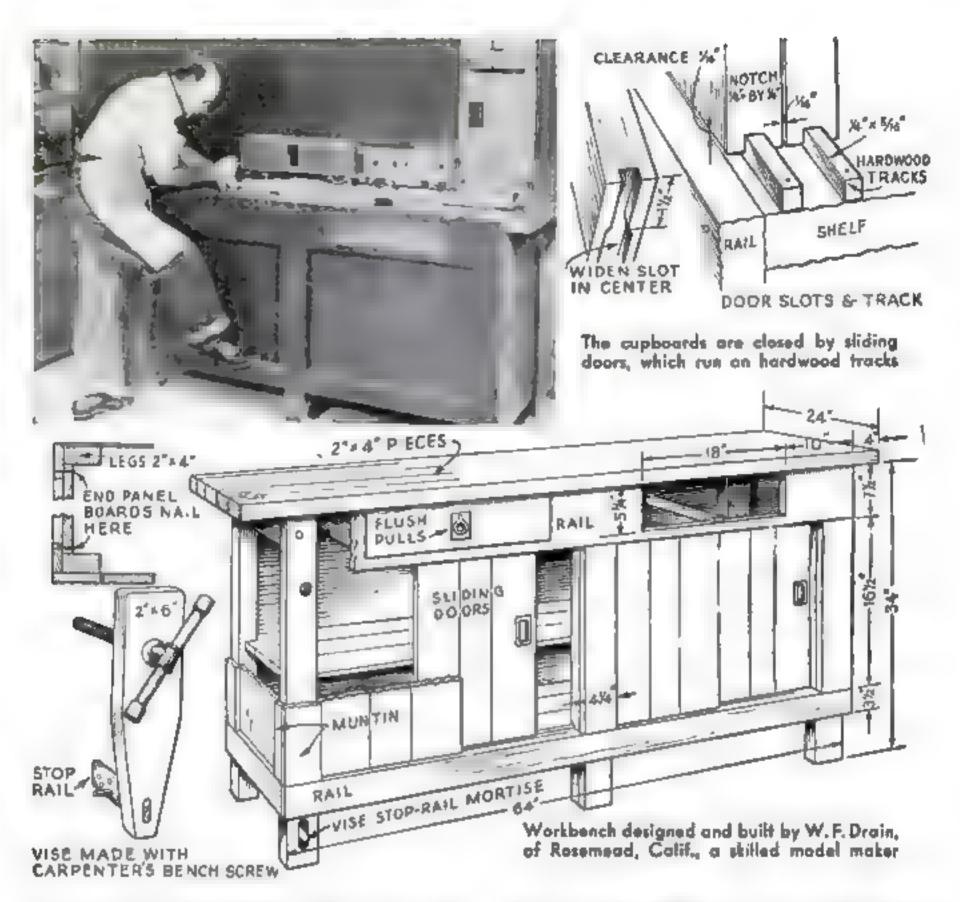
Expense can be saved by ordering rough stock and sizing it on a power jointer, if available. Also, thicker and wider sticks are obtainable than if dressed material is purchased. Although the thickness may be random, the width of all pieces must be equal. Lay them edge up on the floor, one end even, and square lines across where the bolts are to be. Square across the faces and gauge from the upper edges to locate the bolt holes for boring.

Unless a helper and plenty of clamps are at hand, do not attempt to use hot glue. Casein give is better. Insert the iron rods in the first stick, coat the face with glue, and apply glue to the joining face of the second piece. Thread it on the rods, and proceed until the assembly is complete. Tighten the bolts and group such clamps as are at hand around one bolt, placing them



for the HOME SHOP





on both sides of the slab. Tighten the nut, remove the clamps, and treat the next boit similarly. Go over them all two or three times in the same way.

Now wipe off the squeezed-out glue and rest the siab on sawhorses. Lay a strip of wood across each end, and sight over them to detect any wind (twist). This can be largely taken out by driving down the high corners with a hammer and block. Replace the clamps and set the top aside to dry for at least twelve hours.

The heavy members of the frame are assembled with draw-bolt joints (P. S. M., Dec. '40, p. 184). Brace the assembly with diagonal strips of wood and cover the back with ¼" plywood wall board attached with dabs of glue and short nails. Also sheathe the partition and put in the shelf. Notch the drawer runners over the rails, being careful to square them with the front.

Fix the top to the frame with a cleat screwed at each end. Let it lie loosely on the frame, level it with wedges, and screw the cleats to the frame. After the ends have been covered with plywood, the bench will be found to be thoroughly rigid.

Smooth the top by planing diagonally, and finish with lengthwise strokes. Occasionally test it for wind, and check with a straightedge. Scrape smooth, cut the ends to length, and sandpaper. Fit the vise by notching the fixed back jaw into the edge of the top. It is a good idea to face the jaw with a thin board, such as a piece of plywood. The notch should be deep enough to bring the wooden pad about flush with the edge. Screws also enter the underside of the top, and according to the thickness of the top and construction of the vise, the top will have to be notched beneath, or possibly shimmed out, to suit.

Vises are obtainable in several sizes and qualities. The type used for our model bench, retailing for about \$4.50, has 10" jaws that are 3" deep and open to 9", with an adjustable stop pin in the front jaw. Quick-acting vises that slide in and out at

a partial turn of the handle, and lock and clamp with a haif turn or less, cost \$9 up. They are timesavers and desirable if the money can be spared. Make stop holes in the end of the top by boring 1" holes and squaring them with a chisel. Cut a 4" long pin to fit.

The drawing clearly details the bench stop. It is a hardwood flap screwed to the T-leaf of a heavy hinge, which in turn is mounted under the top. Through a hole in the stop a handrail screw with a lag-screw thread is passed and screwed into a suitable hole bored in the top.

Make a bar-clamp as shown, Saw through the frame of an inexpensive C-clamp and bolt it to the end of a hardwood strip. The screw is blocked to keep it from springing outward under pressure.

Fit the rest of the frame parts and add the tray cleats at the sides of the knee opening. The tray bottom is let flush into a rabbet in the tray frame, and small cleats are nailed beneath near the ends to afford

handholds for drawing it out.

The small drawer above also has its bottom rabbeted in. The front projects 4" below to close the opening at the bottom. A pair of triple trays for small brads rest in rabbets made in the upper edges of the drawer sides.

The drawers are lipped, with ends and tops lapping ¼" over the sides and rails. Round the corners to ¼" radius. The upper drawers, since they close under the top, have no upper lips; otherwise the construction is standard.

Remove the top bolts and counterbore to sink the nuts. If the nuts are screwed on the rods before cutting the latter to length, the threads will be cleaned as the nuts are backed off.

Screw down the tool-tray board, screw the backboard to its back edge, and fit beveled blocks at the ends to make it easy to sweep the tray.

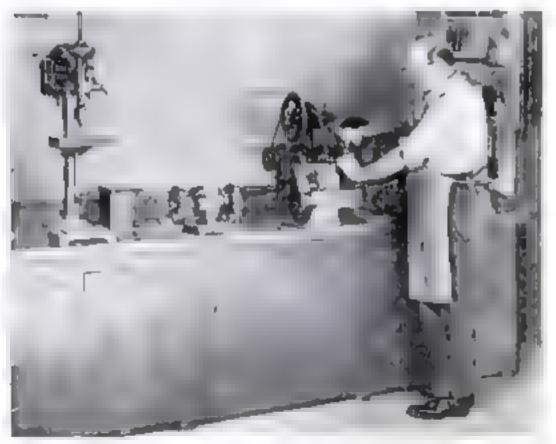
A good bench deserves a good finish. Prime the top with equal parts of pure turpentine and four-hour floor varnish, dry twenty-four hours, and sand lightly with 4/0 garnet paper. Then dust off and finish with full-body four-hour floor varnish, gloss or egg-shell. Dry three days before using. Color is the modern trend in shops, but a natural finish is satisfactory for the body. Rub the lower edges of the drawers and also the runs with soap or paraffin for easy sliding.

There are, of course, many other excellent ways to build a workbench, and plans are given for one designed by Walter F. Drain, of Rosemead, Calif., a skillful craftsman and model maker. It is equipped with two drawers and two cupboards closed by sliding doors. In this case the vise is an inexpensive one made with a carpenter's bench screw.

Materials for Popular Science Workbench Part Na. Bize (stock) Length Material Top 72" 2"x3" cough Hardwood 10 Billes (legs) 6 2"x4" rough or 848 3t la"net Fir 1 2"x4" rough or 248 Fir 46" Rat a 21" Ralle 1 2"x4" rough or 848 Fie Ralls 5 9"x4" rough or 848 17" Fir 1 2"x3" rough or 848 Rolls 30" Ptr 1 2"x3" rough or 848 17" Fir Rassa Tool tray 2 1"x8" 818 72" File and back 4 1"x3" 848 21" File Drawer rada 2 1"x3" 848 30" Fir Drawer rans Drawer runners 6 1th net x 2" 24" Fir 24" 1"x1" B48 Fir Drawer runners 4 Knotty Drawer fronts 2 1"x12" 618 pine No. 2 and sides Knotty Drawer fronts 1 1"x12" 948 pine No. 2 and nodes Knotty Drawer fronts 1 1"x10" 845 8' pine No. 2 and sides 34" Contposi-Noll tray 1 % "x12" Hon

Hardware 4 from rods \$\frac{1}{4}\$" diameter, 18" long, threaded brile ends with note and washers 12 carriage bolts with note and washers 12 carriage bolts with note and washers 5" x \$\frac{1}{4}\$" 1 \$\frac{1}{4}\$" x \$\frac{1}{4}\$", 7 \$\frac{1}{2}\$" x \$\frac{1}{4}\$", 1 \$\frac{1}{4}\$" wide 1 handraif bolt 1 small C-clamp 1\$\frac{1}{2}\$" flatheast wood acrews, 4 roder skate wheels, 2 door holders, 1 woodworker's from tise

2 14 "x48"



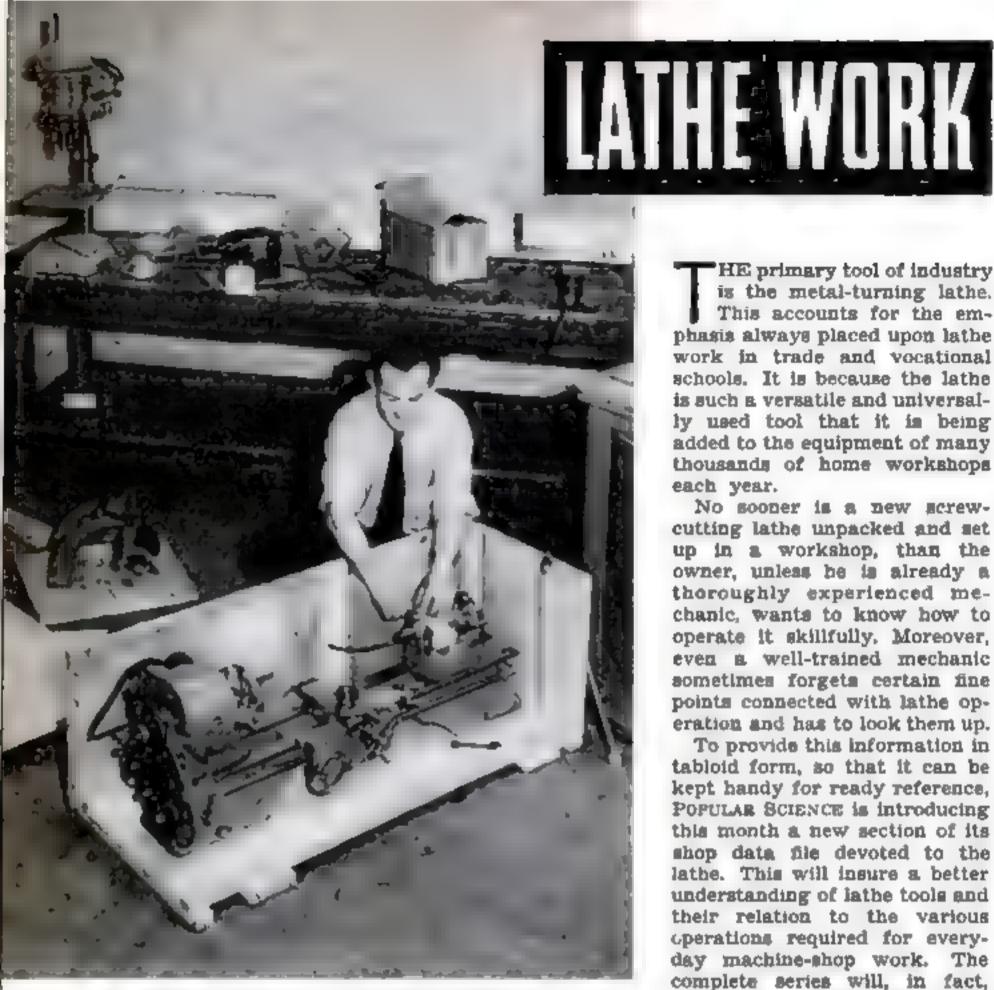
Three of Mr. Drain's machines are mounted on a roomy cabinet. The top is covered with 1/2" pressed composition wood

Drawer bottoma,

abenthing

3 ply ar

wall board

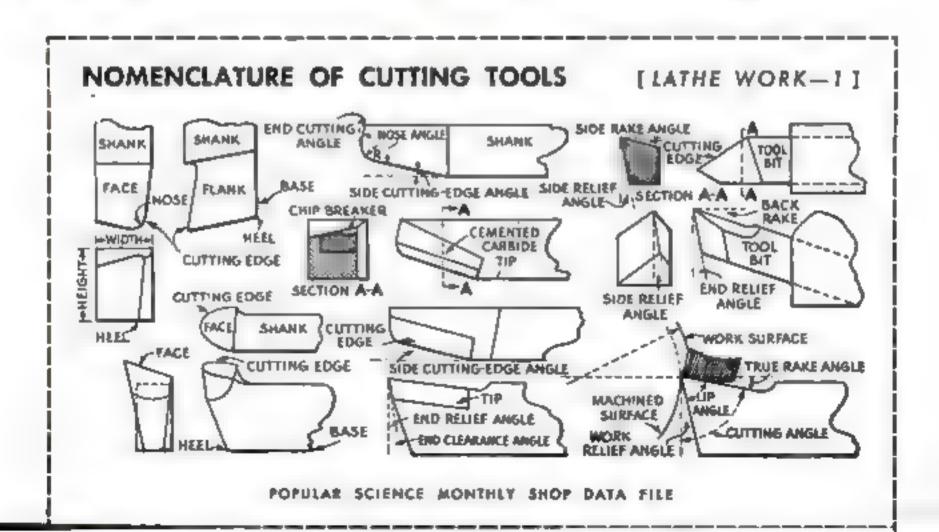


The "brill of unpacking a new metal-turning lathe soon gives way to greater thrills as its owner learns how to operate it

HE primary tool of industry is the metal-turning lathe. This accounts for the emphasis always placed upon lathe work in trade and vocational schools. It is because the lathe is such a versatile and universally used tool that it is being added to the equipment of many thousands of home workshops each year.

No sooner is a new screwcutting lathe unpacked and set up in a workshop, than the owner, unless he is already a thoroughly experienced mechanic, wants to know how to operate it skillfully. Moreover, even a well-trained mechanic sometimes forgets certain fine points connected with lathe operation and has to look them up.

To provide this information in tabloid form, so that it can be kept handy for ready reference, POPULAR SCIENCE is introducing this month a new section of its shop data file devoted to the lathe. This will insure a better understanding of lathe tools and their relation to the various operations required for everyday machine-shop work. The complete series will, in fact, serve as a short, up-to-date course in lathe work.



TOOL FORMS AND METHOD OF GRINDING [LATHE WORK-2]

RECESSING

CUT-OFF

ROUND NOSE





GRINDING RIGHT SIDE OF TOOL BIT



ROUNDING MOSE OF TOOL BET



GRINDING TOP-SIDE RAKE



HONING CUTTING EDGE OF BIT

POPULAR SCIENCE MONTHLY SHOP DATA FILE

GRINDING TOOLS FOR VARIOUS METALS [LATHE WORK-3]

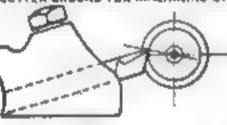


ER GROUND FOR MACHINING STEEL



CUTTER GROUND FOR CAST IRON

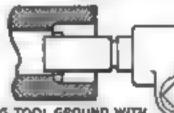




CUT-OFF TOOL BROWND FOR STEEL OR CAST IRON









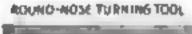
POPULAR SCIENCE MONTHLY SHOP DATA FILE

HIGH-SPEED STEEL TOOLS

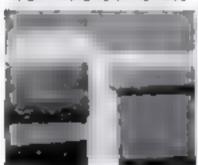
[LATHE WORK-4]

RIGHT-HAND TURNING TOOL

LEFT-HAND FACING TOOL

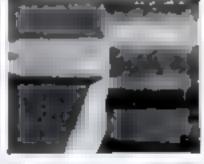


RIGHT-HAND FACING TOOL





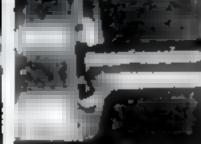
RIGHT-MAND FACING 700L





THREADING TOOL





BORING TOOL CUT-OFF TOOL

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Cutting Threads on Both Ends of Short Pipe Nipples



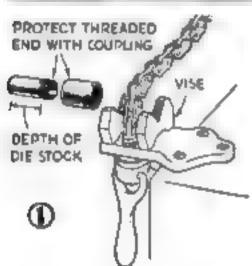
WHEN threads have to be cut on short pipe nipples, the problem of how to hold the work in the vise presents itself. The depth of the pipe diestock and the clamping distance of the vise must be taken into consideration if threads are to be cut on both ends.

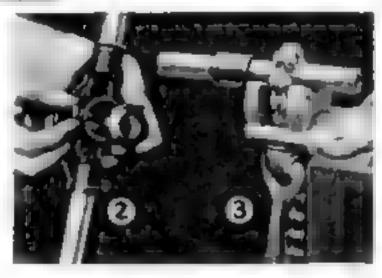
A piece of pipe that is just long enough to be gripped in the vise and still pass through the diestock can be threaded on one end in the usual way. Then, to avoid having to grip this end in the vise in order to thread the other end, a coupling should first be acrewed on over the threads (Fig. 1).

Still shorter nipples can be handled, providing one end is already threaded, by screwing on another piece

of pipe in addition to the coupling (Fig. 8).

In case the guide of the stock strikes the adjoining coupling before the threads can be cut to the proper length, it can be removed and the cut finished without it (Fig. 2). Extremely short nipples can be made in this way by continuing the thread up the pipe until the desired nipple length is reached, after which the waste can be cut off with a back saw (Fig. 4). Take care, when cutting without the guide, to avoid twisting the stock.





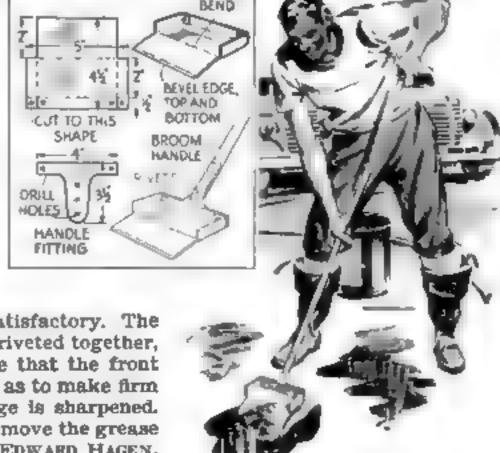


Scraper Quickly Removes Grease from Garage Floor

Have you ever watched a garage mechanic scrape grease from the floor and, after a thin layer had been loosened, patiently try to remove it by sweeping it up with a broom? When this is done, most of the grease merely cakes and stays where it is. With the tool illustrated, however, it can be scraped and collected at the same time, thus solving the otherwise exasperating problem of getting rid of the grease after it has been scraped free.

Any scrap of fairly thin but tough sheet metal will do for mak-

ing the scraper. Even brass will be satisfactory. The scraper itself and the handle fitting are riveted together, then bolted to an old broomstick. Note that the front section of the scraper is bent downward as to make firm contact with the floor and that the edge is sharpened. An old putty knife can be used to help remove the grease from the scraper into a rubbish can.—EDWARD HAGEN.

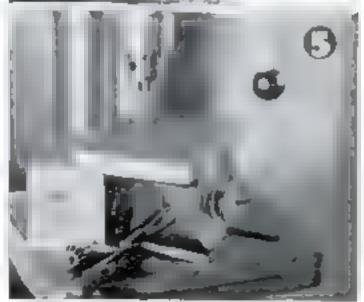










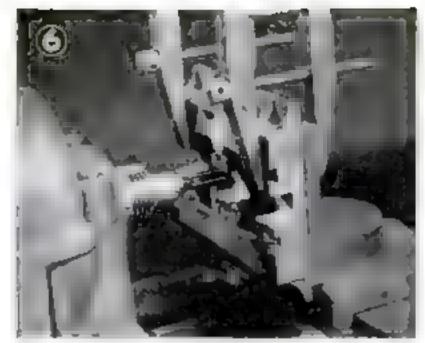


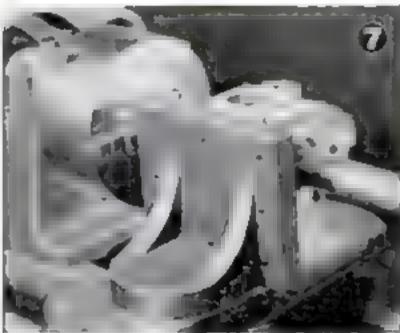
Cross-Slide Angle Plate AIDS IN BORING AWKWARD WORK

OR boring small work in the lathe that cannot be held in the chuck, an angle plate of the type illustrated in Fig. 1 will be found a great convenience. It is mounted on the cross slide.

If the angle-plate dimensions given in the drawings are suitable for your lathe and the kind of work you are ordinarily doing, you can build a wooden pattern by adding 3/32" for machining allowance. Have a soft gray-iron casting made from the pattern.

The face and edges of the casting were machined in this particular case on a small shaper as shown in Fig. 2 while the remainder of the work was done on the lathe itself. This was a difficult piece to chuck, but by laying a steel bar across two of the chuck jaws as in Fig. 3, it was firmly held in the four-jaw chuck for machining the base and



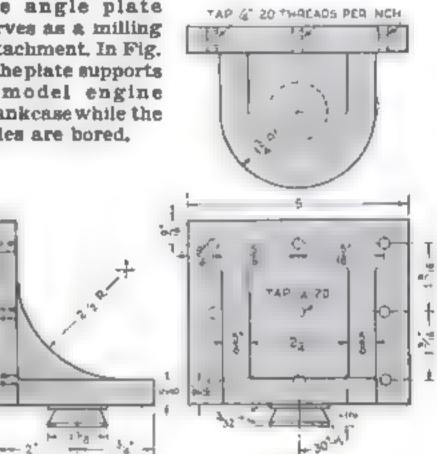


Two uses of the plates to hold work while a slot is being milled (upper view) and to brace a model engine crankcase for boring

the lug. This lug clamps the angle plate to the cross slide and is a duplicate of the one on the compound rest. When this had been turned to size and the base smoothly finished, the angle plate was checked for accuracy with a toolmaker's square. Figure 4 shows the work done thus far, while in Fig. 5 the nine screw holes are being drilled with a No. 7 drill for tapping ¼ "-20.

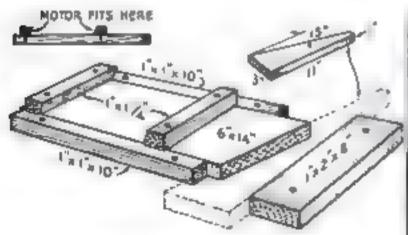
The finished plate is shown in use in Fig. 6. A casting has been fastened to the plate while an end mill in the lathe chuck is cutting a

groove. In this way the angle plate serves as a milling attachment, In Fig. 7 the plate supports a model engine crank case while the holes are bored.



A Simple Adjustable Mount for a Shop Motor

ONE of the easiest of the many possible ways of mounting an electric motor to run home-workshop machines is that shown in the illustrations below. At a touch of the finger, the slide may be adjusted with the wedge to suit different-sized pulleys. It is an equally simple matter to move the motor from side to side for aligning the belt. While the motor is not bolted down, it is held securely, and it may be lifted out whenever necessary for use with other machines in the shop.—LESTER STRATTON,



The base of the motor fits between two cleats on the sliding board. The beval on the rear cleat is sufficient to hold down the motor while in use



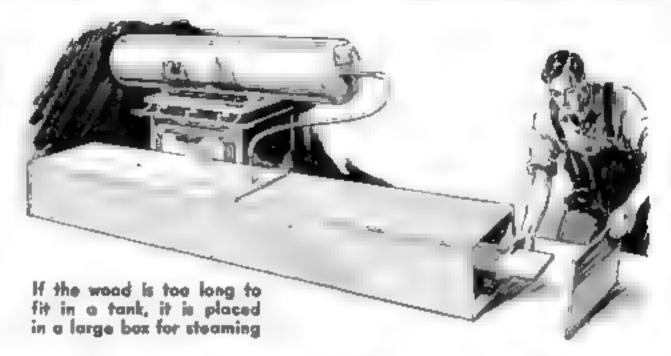
Discarded Hot-Water Tank Serves for Steaming Wood

FOR steaming wood preparatory to bending it, the arrangement illustrated has proved satisfactory in boat repair work during many years past. All that is needed is a discarded hot-water tank, some pipe fittings, lumber, a garden hose, and a source of heat—in this case an old gas range.

Have a hole cut in one end of the tank as shown and make a suit-

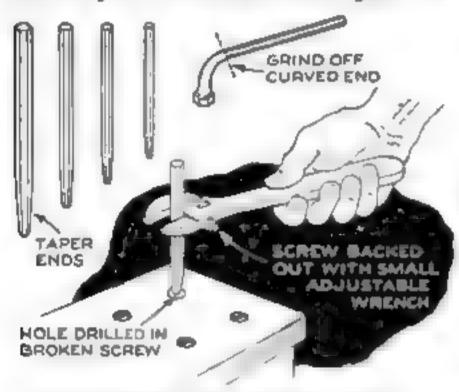
able cover. This may be a piece of 12-gauge sheet metal large enough to overlap about 1/4" on all sides of the opening. Drill and tap two holes in the tank so the cover can be bolted in place with a rubber gasket cut from an old inner tube. The other outlets in the tank may be plugged with metal plugs or ordinary wooden plugs.

If the wood to be steamed is short enough to go into the tank, simply fill the tank half full of water and let the wood float in the water. Fasten the cover loosely enough so that some of the steam can escape. Do not under any circumstances let the pressure



sion. Leave the wood to be boiled and steamed for at least two hours; then fish it out and bend it quickly before it can cool.

When the wood is too long for the tank, build a wooden steam box as illustrated. The wood is inserted from one end and a cover is nailed on. Connect the box with the hot-water tank by means of a rubber garden hose. This is done by inserting a ¼" reducer in place of one of the plugs in the tank, and fastening a length of pipe to it; then thrust another length of pipe into a hole in the center of the steam box.—MATHEW DESEVIC.



Powerful Screw Extractors

A SET of screw extractors that are more durable than the ordinary spiral type can be made from the five smallest sizes of safety set-screw wrenches. First, grind off the curved end; then carefully taper one end to about two thirds its full size, being careful to preserve the hexagonal shape. To use, a hole is drilled in the broken screw that will allow an extractor to be driven in with a hammer, A small adjustable wrench is applied to back out the screw.

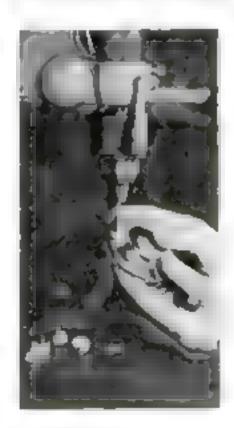
Small Irregular-Shaped Parts Polished with Manicure Pads

Polishing pads or tips of the type shown, made for use with a manicure machine, are excellent for polishing amail, irregular-shaped articles. The tips consist of flat, flared, or rounded felt disks cemented to a metal arbor that can be fastened in a drill

press, hand carver, or flexible shaft. The felt may be charged with any abrasive or polishing powder.

Besides being used for routine polishing, the tips can be employed to give a figured effect on polished metal surfaces, similar to the decorative pattern often seen inside the case of a watch.

These pads can often be obtained from a local beauty shop for little or nothing.





When used at full power, the transformer produces an arc that will burn holes through sheet metal

Electric-Arc Soldering

Port II

By HAROLD P. STRAND

ERY little work is needed to finish our electric-arc soldering and lead-burning outfit. Place the primary-secondary coil on the open end of the core and replace the laminations as in Fig. 8. Note that the heavy secondary ends are at the top (right side in photo) and the primary taps are at the sides of the core. No taps are made at the bottom, which might interfere with replacing the core pieces. Thin strips of fiber are pressed in between the core and the coil at two sides to aid in squeezing the laminations together. Bands of tape passed around the lower leg of the core serve for the same purpose there, so that loose laminationa cannot vibrate.

With all pieces in place, attach the other two side irons and gently tap all laminations so the joints will be tightly driven together. In Fig. 9 the transformer has been assembled that far and in addition two 125ampere copper lugs have been soldered to the ends of the secondary winding. Holes in the lugs are reamed to clear %" bolts.

The top board is made of %" plywood and given two coats of flat black paint. Two 2" by %" brass machine screws with washers, nuts, and wing nuts are used for the terminal posts.

The four-point switch is next made as shown in the drawings, and holes are bored for this and the single-pole switch in the top board.

After the connections have been made, the unit appears as in Fig. 10. For the supply cord, No. 16 heavy-duty extension cord is used, and No. 4 motor lead wire will be found serviceable for the electrode wires. This has a light but durable covering and is very flexible. It can be obtained in almost any motor rewinding shop.

The carbon holder can be made in a number of ways. Two methods are suggested in the drawings. The writer used a heavy solderless wire connector in which a hole was drilled to receive the threaded end of a 7/16" brass rod. A soldering-iron handle was drilled through to fit snugly on the rod, and the 90-ampere lug of the electrode wire

was held tightly between two brass nuts.

A little filing with a round file was neceseary in the connector to make it fit the 9mm. carbon recommended for general use. Larger or smaller carbons can be used as required. The smaller ones are clamped in the same connector, and a wire connector of the next larger size is prepared to fit on the end of the rod for heavier work.

The sliding-sleeve type of bolder is also serviceable and, in fact, is preferred by some mechanics.

To use the transformer for soldering, place the switch on step 1 or 2 and turn the single-pole switch "on." Clamp the grounding clamp to the work or to a piece of metal in contact with it. The end of the carbon

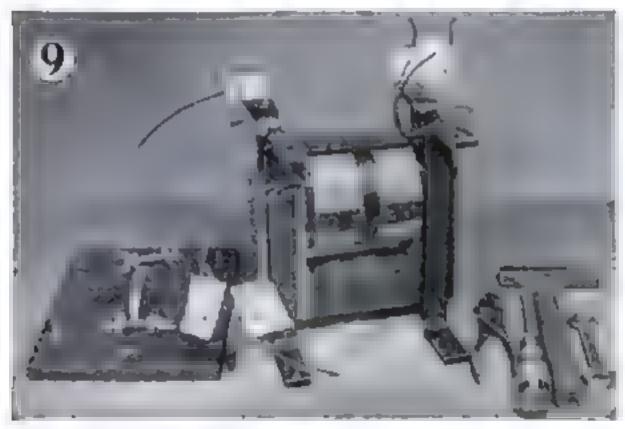
can now be touched to the work and it will quickly heat to a red temperature. In a few seconds this will increase to a white heat, and if solder is applied to the cleaned and fluxed spot, it will flow in perfectly. The carbon is moved along, followed by the solder. In spite of the tendency of a large mass of metal to draw away the heat, continuous soldering can be accomplished.

For heavier work, step 3 of the switch may be used. In some work the carbon can be slightly drawn away to form an arc. This method will be especially useful on step 4 when cutting or burning sheet metal. It produces a great heat—approximately 4,000 deg.—at which steel drips almost

like a cake of melting ice.

8

The taped coil is placed on the open end of the core and the laminations replaced. Weave them in as they were originally arranged



Next, the remaining side irons are clamped on. Then the terminal board is cut out for the switches and boited to the side-iron tops

The input and output of this transformer will vary with the length and diameter of the carbon used. as well as with the distance between the spot touched on the work from grounding clamp. In addition, unlike ordinary metal conductors. which increase in resistance and consequently provide lower conductivity with an increase in temperature, carbon is the reverse. As the temperature increases, it lowers in resistance and more current will flow. This means that the longer it is held to the work and as the color changes from red to white heat, an increase in current both in the primary and secondary will follow until the maximum value is reached.

Tested with a piece of 9-mm, carbon projecting 3" from the holder and held about a half minute to the work on each of the four steps, the following meter readings were obtained (maximum):

Step 1—primary amperage, 1.7; secondary voltage, 5, secondary amperage, 2.8; secondary voltage, 5.8; secondary voltage, 5.8; secondary amperage, 70. Step 3—primary amperage, 5; secondary voltage, 7.6; secondary am-

perage, 90. Step 4—primary amperage, 11; secondary voltage, 9; secondary amperage, 120.

With no load, the secondary voltages were respectively 5.1, 6.1, 8.2, and 10.1, so it can be seen that a reasonable and permissible drop in voltage takes place at full load. This gives the transformer a minimum rating of 200 watts and a possible maximum of 1,080 watts. It is a good plan, however, to use no more current than is actually necessary for the particular work.

Use the fourth step of the switch for short pe-

riods only, because it somewhat exceeds the capacity of the iron core for continuous use. Nevertheless, the core will stand overloading for intermittent service.

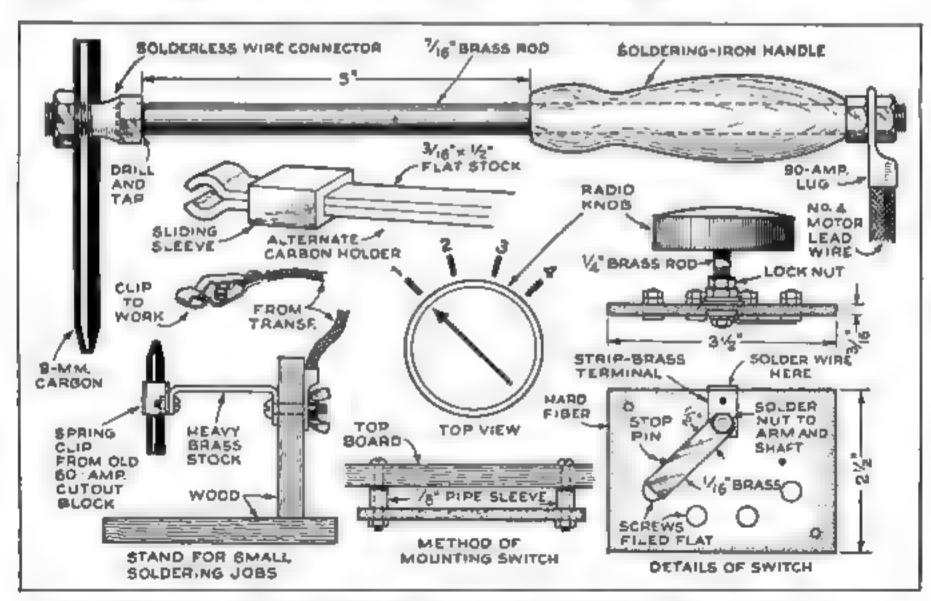
Most soldering can be done on the first two steps, with the third reserved for heavy metal. Step 4 will be found useful for burning and cutting light metal and making edge welds in sheet metal. With practice, a small welding or brazing rod can be fed into the molten metal to build up where required. Lead burning can be done on steps 3 and 4.

In using this transformer, guard the eyes from the intense light when the carbon is



The taggle switch in front turns the transformer on and off, the fourpoint ratary switch provides four secondary voltages to suit the work

white hot. Goggles of the type used in arc welding are recommended, but a pair of very dark sun glasses will answer if at hand. Leather gloves can also be worn for protection from sparks or bits of molten metal. This is more necessary on steps 3 and 4 of the control switch, where a very high wattage is delivered to the carbon. Because of the comparatively low voltage in the secondary windings of the transformer, there will be no danger from shock. Never attempt to use a welding or brazing rod in the carbon holder. If carefully built, this transformer should give long service.



Carbon holders, switch, and other details. The carbon can be clamped in a stand or held in a handle

Big Rubber Band Keeps Plug from Pulling Out of Socket

WHEN an electric appliance or tool is plugged into an extension cord, the plug has an annoying tendency to pull from the socket on the slightest excuse. Sometimes



the parts are wired together, but this is not entirely safe. A better method is to use a heavy rubber band attached as shown at the left so that the plug will hold securely, yet may be quickly removed without difficulty. The rubber band can then be placed around the cord, available for future use.

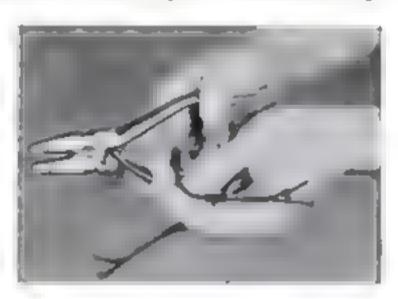


Flexible Lamp Cords Joined by Using a Fisherman's Knot

A SECURE way to connect two pieces of flexible lamp cord end to end is to remove the insulation for a somewhat greater distance than usual and tie the wires together with a fisherman's knot, as shown, rather than use an ordinary twisted splice. The joint should be soldered and wrapped with rubber and friction tapes in the usual way.

Handle Side of Pliers Used for Stripping Insulation

Insulation is easily removed from the end of a wire with ordinary side-cutting pliers used as shown at the right. Insert the wire between the handles just back of the pivot pin. A slight pressure on the handles will then mash the insulation so that it either comes off in the process or may be pulled off with little or no effort.—R. B. S.

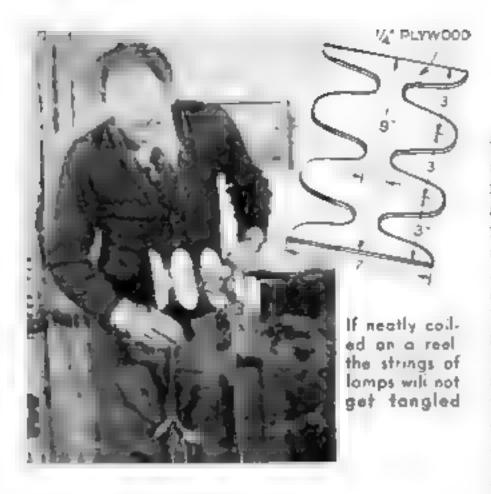


CAPACITY OF COPPER BUS BAR

I ELECTRICAL 1

When building or connecting up apparatus in which flat strips of copper bus bar are used to carry current, one should know the carrying capacity of this material, because it cannot be found from a table of carrying capacities of round copper wires. Carrying capacity is figured at 1,000 amperes per square inch.

Thickness	Width	Area in square Inches	Capacity (amperes)
1/16 1/16 1/16 1/16	1% 1 1%	.0313 .0469 .0625 .0938	80 50 60 90
74 74 74 74 74	% 1 1% 2	.0625 .0938 .125 .1875 .25	75 90 125 200 250
14 14 14 14 14	1 14 14 14 2	.1875 .25 .3125 .375 .4375	185 250 315 375 435 500



Reel for Xmas-Tree Lights

ONE chors that often mars the Christmas spirit is unraveling the old strings of lights before decorating the tree. This can be avoided by making a reel from ¼" plywood as shown. It provides slots for winding three sets of lamps.—F. H.

Testing a Small Cartridge Fuse

For testing nonindicating cartridge fuses, one maintenance man uses a flash light with the end cap removed and the switch in the "on" position. The flash light and a good fuse or short piece of metal are held as shown. The fuse to be checked is then press-



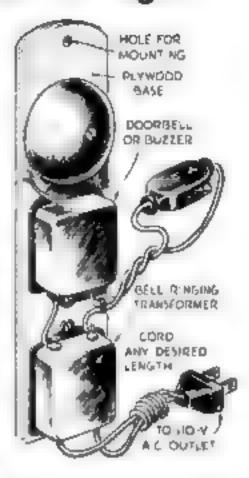
ed against the flash-light battery and the good fuse so that the electrical circuit is completed. If the buib flashes on, it is clear that the doubtful fuse is all right; if the buib does not light, the fuse is blown and is discarded.—Morris Katz.

Using Flash-Light Cells Longer

WHEN a two-cell flash light of the prefocused type is used a great deal, the batteries and bulb can be made to give longer service by substituting a bulb intended for use in a three-cell light of the same type. The lamp will still give ample light.—R. A. C.

Invalid Can Ring for Help with Portable Call Signal

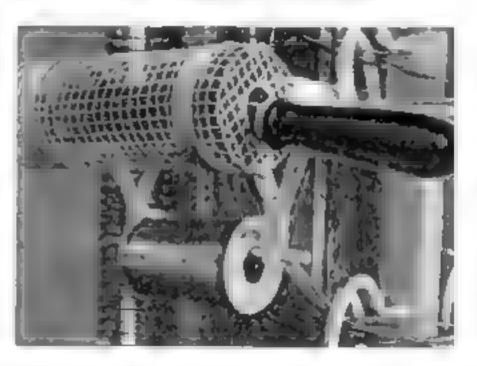
To enable an invalid to attract the attention of others in the home, a portable electric signal is easily made as shown in the accompanying diagram, A push button may be substituted for the feed-through switch, a buzzer for the bell, and dry cells for the transformer, if preferred. The longer the switch cord, the farther the bell may be placed from the Bick per-



Other uses for the portable call signal will suggest themselves. For example, the unit could be taken into a darkroom by the photography enthusiast who expects to be called but does not want the door opened unexpectedly, or who has his darkroom located in the basement.—William E, Hayes.

Holder Made of Wire Mesh Keeps Soldering Iron Handy

ELECTRICIANS and others who use an electric soldering iron constantly will find this holder useful. It is easily constructed from square-mesh wire screen woven together with pliers at the corners and held in position with clamps. The holder for a spool of rosin-core solder is an additional convenience. This device may be attached to a workbench or made portable by mounting it on a suitable base.—RAY BLAIN.





Soap Dispensers for kitchen and Laundry

BECAUSE of the design of its spout, the bead-soap dispenser shown in Fig. 1 below limits the amount of soap one can pour to a heaping tablespoonful. This automatic feature is especially desirable for washing dishes, and it eliminates waste.

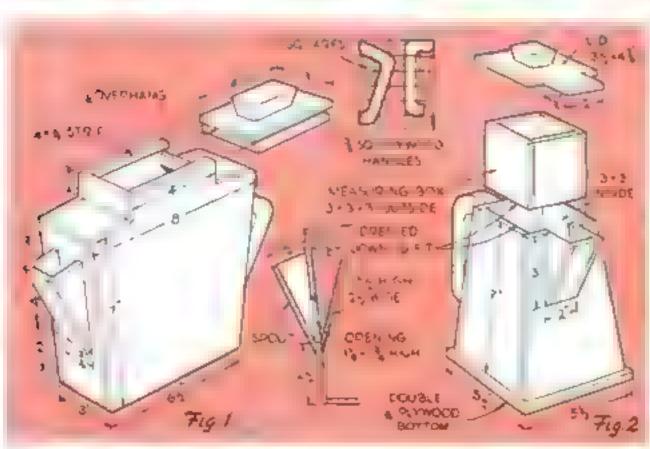
The container is made of %" plywood, and the sliding lid is built up of three pieces of the same material, the center one being narrower so as to form a groove to slide over the strips nailed to the inside of the opening.

In Fig. 2 is shown a dispenser for soap in

either flake or bead form. A measuring box attached to the lid holds one cupful. This is suitable for laundry use, as well as for the kitchen.

The spouts and handles should be assembled before gluing and nailing the boxes together.

Paint the two boxes ivory, and color the spouts, handles, and lid knobs to match the kitchen trim. A flower design transfer or other decorations on the sides will improve the appearance greatly.—FRANK HEGEMEYER.

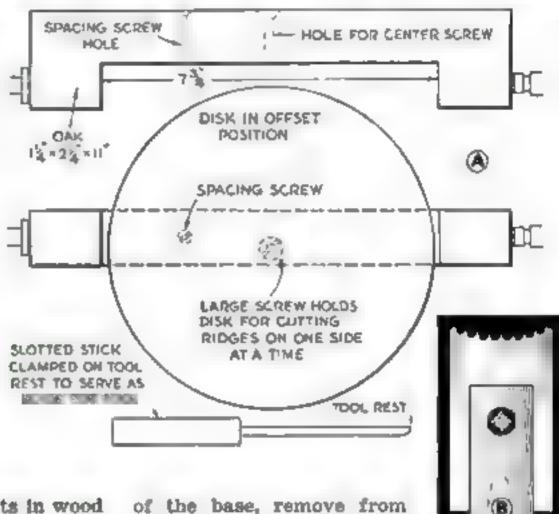


The dispenser in Fig. 1 is for bead soap; in Fig. 2, for beads or flakes

Spiral Inlaying







ODERN decorative effects in wood turning can be obtained by using machine set-ups of the type illustrated. Thin bands can be inlaid spirally around turned columns, standards, or legs; and flat faceplate turnings, such as lamp bases, can be ornamented with vertical fluting on the edges. These methods were used in making the inlaid lamp illustrated, but it is not necessary to copy this particular lamp since the same ideas can be applied to many decorative projects.

The base of the lamp consists, in this instance, of two 7" disks cut from %" walnut stock. Turn the edge of the lower base section to %" thickness, and 5/16" in from the edge turn a ring %" high and %" wide to serve as a circular tongue to fit into a groove in the upper base member. Inside this ring turn down the stock 3/16" more to allow space for the connecting wire to the canopy switch.

Slightly round the edges of the top section

of the base, remove from the lathe, and place in a jig made as shown at A in the drawings. This is used in

the lathe for cutting the vertical ridges as shown above. A special tool is required for this purpose. It is made as indicated at B in the drawings by filing grooves approximately \%" deep in a scraper blade and fastening the blade in a wooden handle.

After the ridges are cut, mount this section of the base on a faceplate and cut a groove to take the projecting ring on the bottom section. Now reverse the work on the faceplate and taper the top side down to ¼" in thickness at the edge, leaving it the full ¾" thickness in the center. Turn a 2" hole in the center to take the standard. Fit in a canopy switch as at C. Now drill a ¼" hole in the side of the bottom section for the wire, and connect the wire to the switch.

For the standard, turn a 3" column from wainut 6" long. To cut the grooves for the

inlays, a jig is rigged up on a bench saw as shown. A thin, smooth-cutting saw blade is best. The blade is lowered to make a cut \%" deep. Place the jig on the saw table at a 40-deg, angle, start the cut carefully, and slide and turn the column at the same time so the saw cut is clean and uniform. The groove slides over the pin, which serves as a guide. Three cuts are made equally distant apart.

Before making the cuts in the opposite direction, the inlays are inserted. The inlays are turned from a 7" maple disk. They must be of a size to fit in the grooves snugly, and slightly tapered to insure a tight fit. Half of a ring is necessary for each cut.

A vise might serve for pressing in these

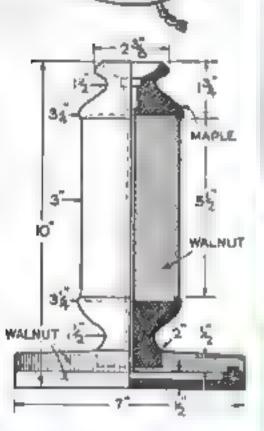
inlays, but the lathe was used in this instance, as illustrated at the bottom of the page. Glue the inlays into place and sand off smoothly.

Reverse the jig on the saw to cut the corresponding grooves in the opposite direction. Be careful to start the cuts so they match at the top of the column. Insert the inlays as before.

Place the column in the lathe and cut off to measure 5%" long, which should make the inlays come together, as illustrated, at top and bottom. On each end of the column, turn a projection %" in from the edge and %" high. These fit into recesses cut into the top and bottom maple sections.

Drill the column parts through the center for the wire. Then assemble the parts of the base and the column with glue. The lamp socket fits down into the top maple section and is attached by means of a short nipple that screws into the standard,

Finish all of the parts before removing them from the lathe. Simply apply shellac and, before it dries, start the lathe and hold against the work a cloth on which some shellac, a drop of oil, and a little alcohol have been placed.—B. N.



GROOVE ON

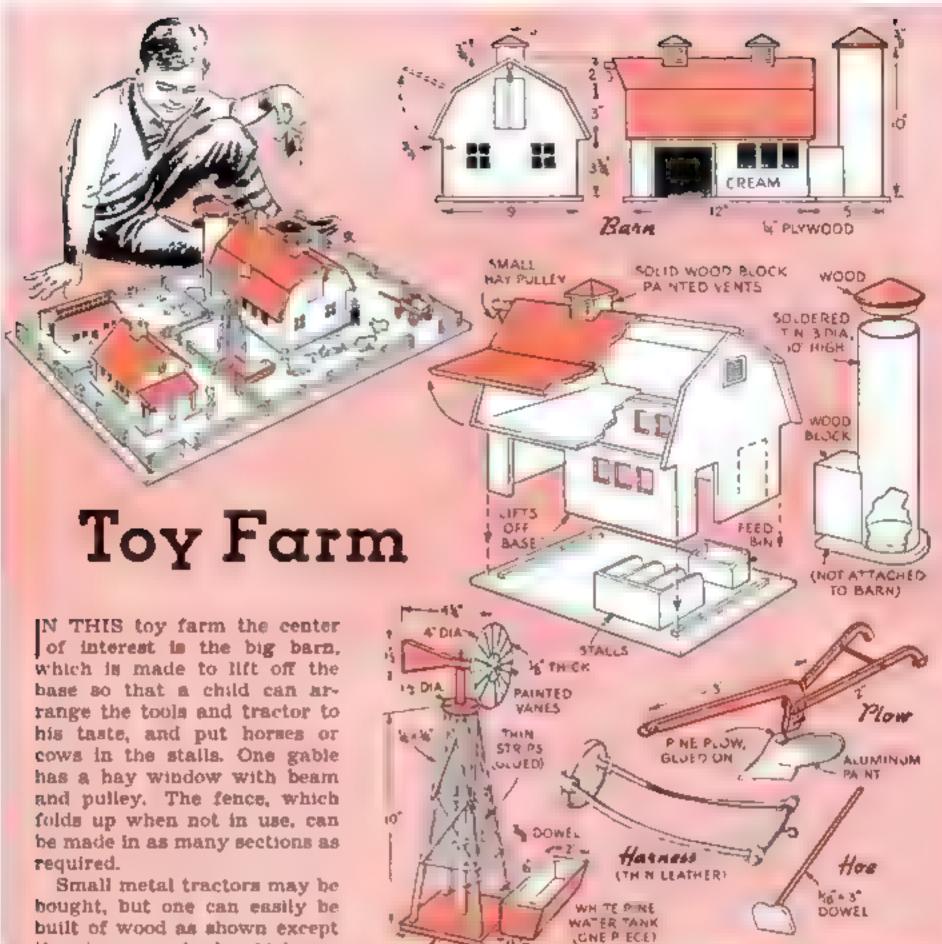
UNDERSIDE OF

TOP SECT ON



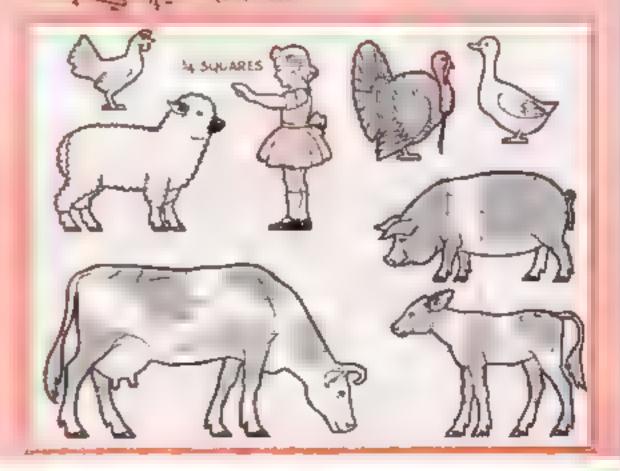


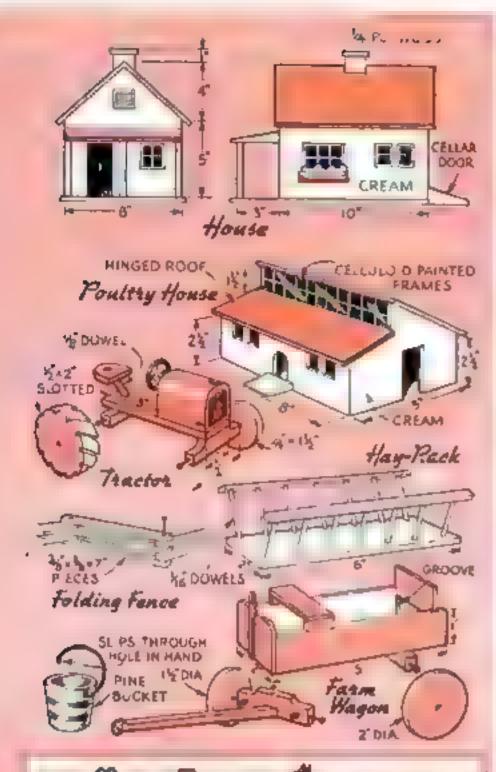




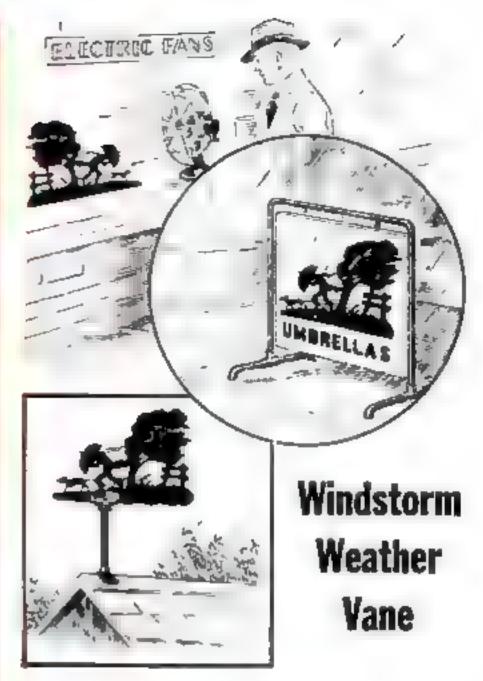
Small metal tractors may be bought, but one can easily be built of wood as shown except the steering wheel, which can be taken from a discarded toy. The hay rack and farm wagon have identical running gear. The plow frame can be made of hardwood, with a combined plowshare and moldboard shaped from white pine. Paint the share and moldboard aluminum, the tongue black, and the handles red.

Figures and animals will stand alone when sawed from wedge-shaped material. The man and woman have holes drilled in their hands to receive various small tools, a halter rope, or the handle of the milk pail.—Hi Sibley.



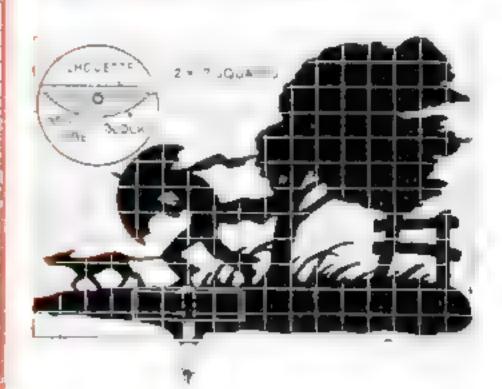






ALTHOUGH designed originally for use as a weather vane, this silhouette can be adapted to other purposes. It would, for example, make an appropriate advertising panel for electric fans, umbrellas, raincoats, and the like.

For outdoor use the silhouette can be cut from either waterproof plywood or sheet metal and mounted as required. If 1" squares are drawn as an aid in enlarging the design, the finished project will be a good size for a weather vane. To change the size, simply lay out larger or smaller squares before starting to copy the pattern.



Marine Coaster Set Turned on a Lathe

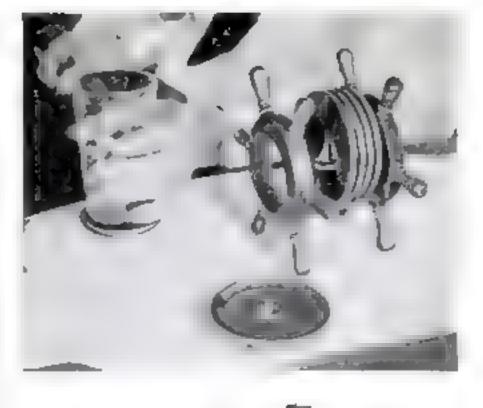


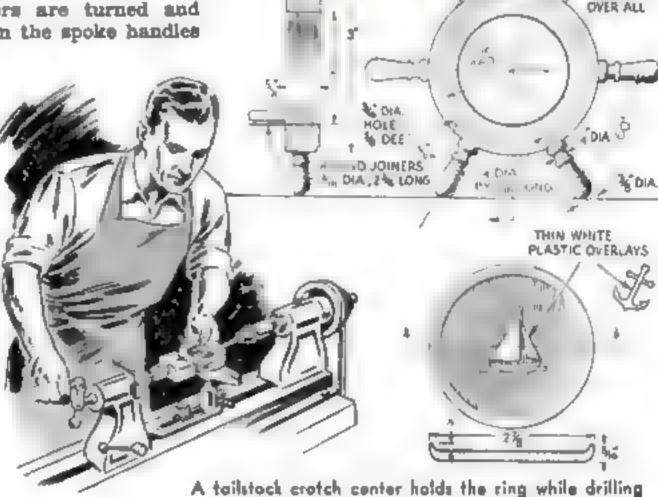
THIS coaster set is a through-and-through-and-through-athe project for the yachtsman who is casting about for something nautical to turn his hand to. Start with the spoke handles, three of which are turned from one piece of

stock, then cut off, and the small stubs sanded smoothly. Next the ring members of the wheels are tooled out from one piece. The lathe index head serves nicely to mark places every 60 deg. for the spoke handles. A tailstock crotch center is handy for drilling the spoke-handle holes with a headstock chuck and drill. Holes for the joiners are drilled, then the joiners are turned and glued into them. Glue in the spoke handles at this time.

The eight coasters are cut from one piece of stock. Allow room between each one to ply the tool, and afterward cut them apart. Do as much of the sanding as possible in the lathe, of course, before removing the pieces. If made accurately, the coasters will nest snugly.

Stain the pieces after assembly, and cement small, white plastic yachting emblems on the coasters to give life to the project.—
BRUCE MACINTOSIL





Toy Wheels from Rolling Pins

IN MAKING toys the matter of wheels is somewhat of a problem to one who does not have a lathe. I merely purchase ten-cent rolling pins for small wheels, and fifteen-or twenty-cent rolling pins for larger wheels, and saw them across on my bench saw. Being bardwood, the pins make good wheels. For softwood wheels, cheap curtain poles offer suitable material.—ARTHUR ROBS.

. . .

THE loud ticking of an alarm clock or other clock housed in a metal case can often be cured by taking off the back and fitting blotting paper inside this piece.



Leather Work Tooled with Empty Pencil

A LONG

LEATHER craftwork is often embellished by stamping background areas with special punches. When suitable punches are not available, an ordinary ten-cent mechanical pencil may be pressed into service. Remove the lead.

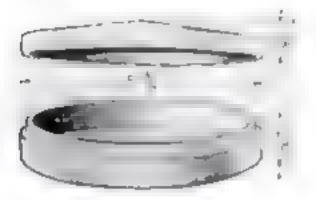
Gay Plastics Ornament Chinese Checkerboard

CAST-RESIN plastics, which lend an air of distinction to so many kinds of craftwork, can be used to enliven a Chinese checkerboard. The 15" dlameter base is cut from five-ply plywood from %" to %" thick, and the hexagonal center and the triangular points are 3/16" plastic. Draw a full-size pattern on paper. The hexagon can be laid out in a circle 7%" in diameter, in which case its sides and the sides of the triangles will be 3 % " long. Scribe clear, uniform lines across the surface of the plastic material with any sharp-pointed tool,

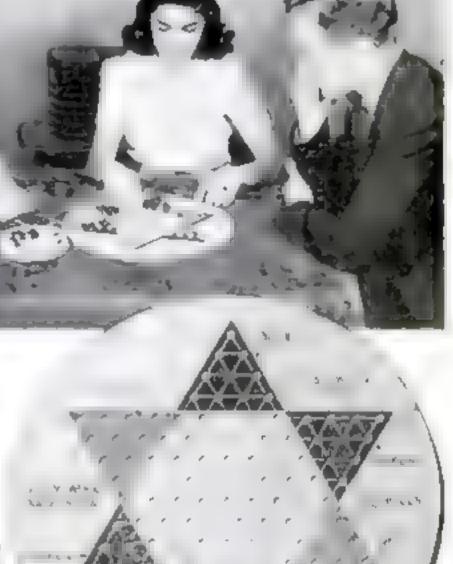
and drill 5/16" holes at the intersections.

After the base has been lacquered, the plastic parts are fastened to it with small drive screws. A box for the marbles may be turned from maple or other hardwood to

the dimensions given below.



Top view of the board and, left marble box. The design is from New York head-quarters of the Metropolitan Junior Achievement



RESISTS

[METAL ETCHING-2]

There are numerous resists or mediums for blocking out and coating metals before they are etched with acids.

Of the waxes, paraffin is widely used, being cheap and always available. The melted paraffin is poured over the metal, which, to obtain best results, should be warm. This gives a thin, even coating. Paraffin and other waxes, however, often prove more or less unsatisfactory, particularly where the design is being scribed in. If the coating becomes too cold and hard, it will chip; if too warm, it will pull,

Asphaltum varnish is the most satisfactory resist for most decorative metal work. When it is allowed to dry hard, it will cut well and leave clear, sharp lines. Asphaltum becomes stiff in cold weather. Keep the can in a warm place, but not too close to a fire. If, when warm, asphaltum is still too thick to spread well, add a little turpentine. An inexpensive material sold in ten-cent stores under the name "stovepipe enamel" is often an excellent grade of asphaltum of just the right consistency to spread well.

Asphaltum is best removed from the metal with kerosene. Lacquer thinner is equally satisfactory, and turpentine will also do the work, although it is slow.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Putting Your SKIS in Shape

By ART HOLMES

Ronger, Yosemite National Park

A little pre-season maintenance now will prolong their useful life and improve their performance.

Start with the bindings. Take them off entirely and check their condition. Steel-wool any rusty places, and oil or shellac them. Repair or replace any worn or weak parts. When you refeaten the bindings, see that all the acrews tighten down firmly. Some of the holes in the wood may have become enlarged and require oversize screws.

Frequently, after a year or so of hard usage, the inside edges of skis not having metal edges will be found to be worn and rounded. This makes skiing—particularly climbing—difficult. Sharp edges may be restored by switching bindings from one ski to the other, which brings the sharper edge of each to the inside. Another way would be to plane down the inside edge of each ski.

Now check the ski tops. It is a good idea to revarnish these surfaces if they are worn or scratched. This improves the appearance and helps to prevent cracking and warping; furthermore, snow will not stick to the slick, shiny surface. Before revarnishing, clean off all wax and dirty spots with turpentine, alcohol, or a cleaning solvent. Sand with fine

sandpaper, and fill all pit holes and deep scratches with putty or plastic composition wood, stained appropriately. Apply several coats of spar varnish, allowing the skis to dry thoroughly between coats. Never varnish the bottoms.

If you want to add a mark of distinction to your skis, paint a small monogram or design just back of the tips. This has a distinct value other than an ornamental one—there is less danger of losing your skis by mistake or design.

Attention must now be given to the bottom or running surfaces. Even new skis usually require a base wax or lacquer treatment before use. The present trend of base treatment is toward the new ski-lacquer preparations, and in many localities this is entirely superseding the old base-wax method.

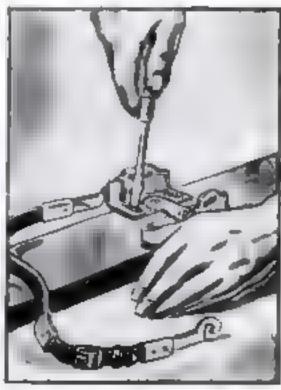
Wipe the skis with turpentine or alcohol and sand them thoroughly before applying the lacquer. Be absolutely sure there is no old ski wax or other oily preparation on the surface. Lacquer will not stick if the slightest trace of wax is present. In case, however, the skis have previously been treated with lineed oil, lacquer will usually adhere provided the lineed oil has been on some time, is thoroughly dry, and has penetrated into the pores. Always clean and sand well.

If a lacquer base is not to be used, then the wood should be impregnated with linseed oil or wax to make it waterproof. Otherwise the top waxes (climbing or downhill) will wear down and expose the wood, which can soon become wet and wear rapidly.

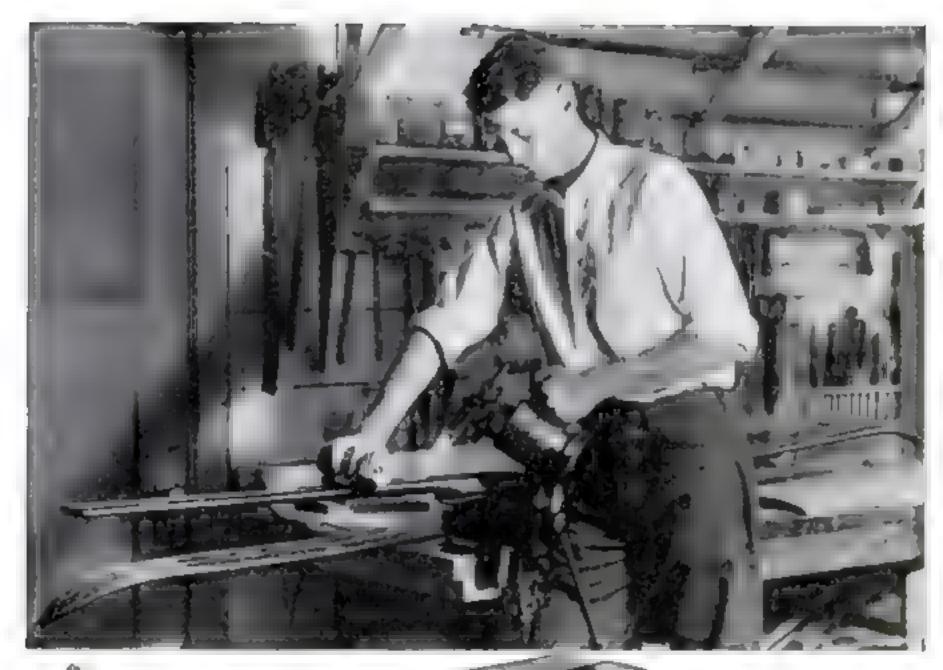
The linseed-oil process is very simple. Clean off all old wax as previously described or by using gasoline. Then brush on coats of hot linseed oil until the wood has taken up all that it can. The excess may be wiped off and the skis allowed to dry, after which a







To replace a worn-out ski-pole handle, you can't beat a bicycle handlebor grip. When inside edges of skis become rounded, change bindings from one ski to the other



While the running surface of the ski is heated with the constantly moving blowtorch, the wax is spread with a cloth

good coat of wear-resisting base wax may be applied.

The other process consists of burning in the wax. Put the ski in a vise and, taking one third of the length at a time, slowly heat the ski with a blowtorch. Keep the torch constantly moving and exercise extreme care not to burn the wood. At the same time, spread a thin coating of wax on the surface with a rag. This wax penetrates the pores of the wood. The wood may be heated to the point, but no more, where tiny bubbles appear on the surface; then immediately allowed to cool. The usual base wax and top waxes are applied on top of this wax treatment.

At this time check the condition of the steel edges, if your skis have them. Replace bent or broken sections and tighten or replace loose or missing screws. Fill each hole with linseed oil before fastening the new screws in place.

Examine your ski poles next. The shank

should be waterproof to prevent cracking. If a crack is starting, wrap wire or adhesive tape neatly around that portion, and varnish over the tape.

Frequently the leather thongs holding the ring to the shank become stretched or worn, and lose their natural oil. Replace broken or stretched thongs, and rejuvenate with boot grease. Also inspect the ring itself. If it is of rattan, it may need varnishing or shellacking.

An inexpensive replacement for the handle is the familiar bicycle handlebar grip. Slip this on the end of the ski pole, bore a hole through the grip and pole large enough to accommodate the wrist strap, and rivet the strap ends together to form a loop of the right size.

Outdoor Wiring Accessories

BECAUSE the common hard-rubber or composition variety of electric sockets and plugs tend to break up when exposed to frost, those used on lamp and extension cords intended for continuous outdoor service should be of the heavy-duty, soft-rubber type.—J. M.

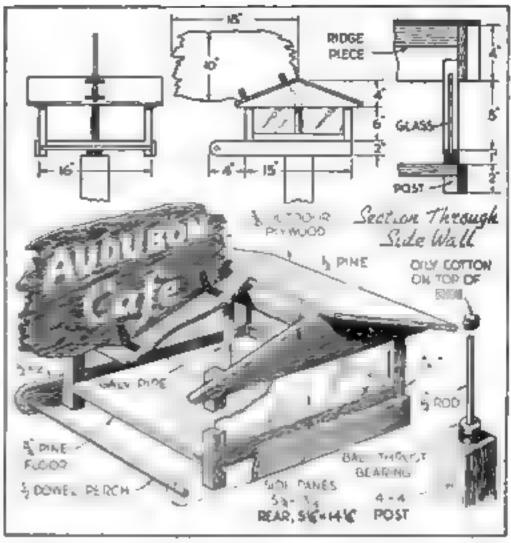


A Revolving Bird Feeder Built with Glass Sides

This sunny, snug bird feeder swings with the wind and protects its feathered patrons at their meals.

Waterproof outdoor plywood is used for the roof, and white pine for the posts, floor, and sturdy ridge piece into which the galvanized pipe is inserted at the top.

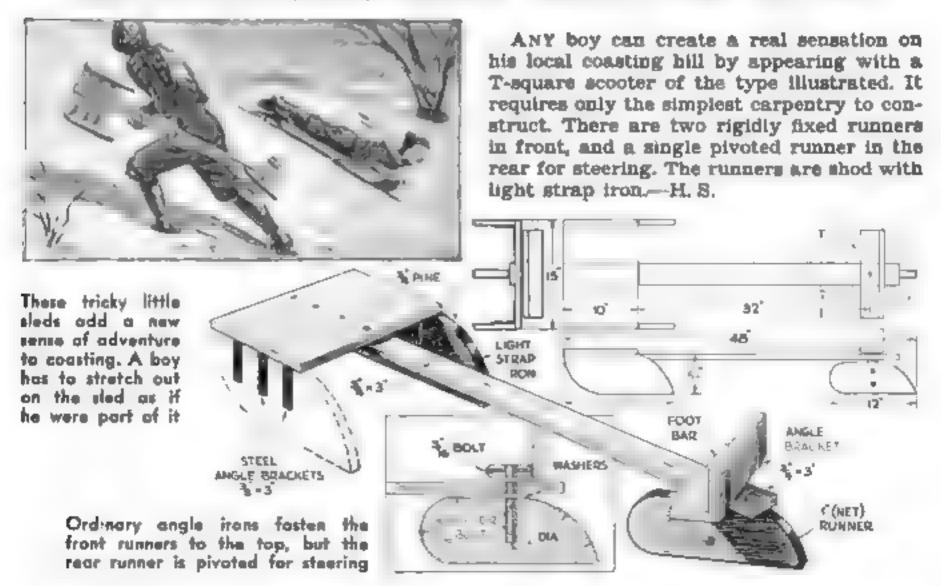
The panes of glass are set %" into rabbets 3/16" deep. The load is carried on a ball-thrust bearing, and a wad of oil-soaked cotton is plugged into the top of the pipe



to keep the axis from squeaking as the shelter revolves with the wind. Finish with outside spar varnish in the natural wood. Add the lettering in bronze or aluminum with fine black borders.

Locate the feeder out of the reach of cats, but not too high to replenish the grain and suct.—DICK HIXON.

Three-Runner Snow Scooter Steered with the Feet



Metal Decoys Aid in Spearing Fish Through Ice

DECOYS to use in the sport of spearing fish through the ice from a fish house—a sport that is popular in many of the colder sections of the country—can be made as shown from sheet metal or heavy tin. The decoys may be from 3" to 8" long and patterned after any desired kind of fish.

Cut the metal to shape with tin snips or cold chisel, hammer it flat, cut slots for inserting the fins, and solder the fins in place. Add extra solder under the frontal fins so that the decoy will glide downward when the control string is slack. Drill a few small holes along the top edge for inserting a small hook and swivel.

For running the decoy, a stick about 18" long with a 6' or 8' fishline is used. The hook and swivel are tied to the end of the line. See that the fins of the decoy are horizontal except the back edges of the frontal fins, which are bent up slightly. Bend the body of the decoy to form an arc so that it will travel in a circle of from 12" to 18". Insert the hook of the control line in whichever hole permits the decoy to balance properly. The decoy may be left in its natural finish or colored, as preferred. A red head with a white body is a good color combination.

The fisherman usually sits by the edge of the ice hole and gives the control line slow jerks with one hand so the decoy will travel in circles. He holds the spear in the other hand and rests the times at the edge of the hole until a fish is seen. The

spear is ordinarily 4' or 5' long.

Decoys of this type can also be used as summer bait by drilling a small hole at the nose and tail. Fasten a gang hook at the tail and a small swivel at the nose. Bend the decoy so it will travel through the water like a crippled minnow.—D. E. LINDSERG.



Skates Given Keen Edge with Half-Round File

A SKATE sharpener can be made by clamping a half-round file between two wooden blocks in a bench vise and drawing the run-



ners of the skates across the rounded surface of the file. Select two sound pieces about 1" by 1" by 5" and saw a V-shaped groove the length of each block; then shape the groove with the edge of the half-round file so the file can be held securely as shown in the detail drawing. The channel should be equal in width to the runner.—John Lapin.

Screen and Storm Doors Hinged to Avoid Unnecessary Holes

PUTTING up and taking down interchangeable storm and screen doors soon enlarges the hinge screw holes, making it necessary either to plug them or change the position of the hinges. To avoid this, I screw the hinges permanently to the door frame and fasten them on the screen or storm door with flathead bolts and nuts. Thus the hinges need never be moved during the life of the door, and the door frame is not mutilated with holes.—William F. Peterson.



Balsa Wood for Model

PART II By FRANK ZAIC

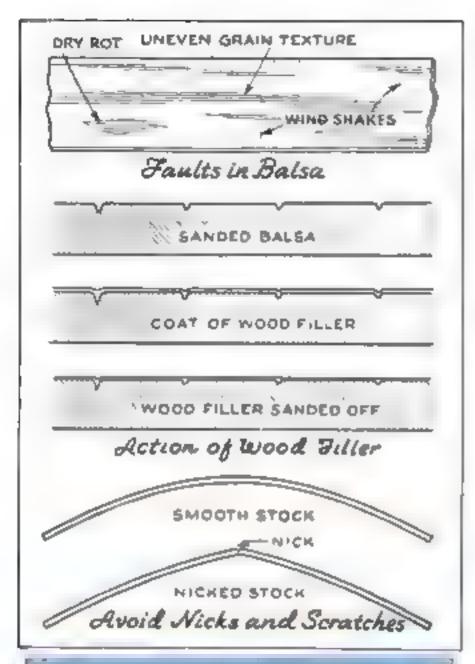
E ARE led to believe that extralight balsa is best for model work to achieve maximum strength with minimum weight. This would be true if a model behaved perfectly from the first to the last flight, and did not meet unexpected obstructions. As a rule, however, models have to withstand severe and sudden shocks. A rigid spar cut from light balsa might crack under sudden impact because it lacks resiliency. In contrast, a spar cut from heavier balsa and of smaller cross section will bend under the impact. As the spar bends, it will gradually absorb the impact force, which is dependent on speed and weight.

Selecting Balsa by Weight. For the ribs, bulkheads, sheet covering, shaping blocks, all balsa outlines, and other parts of a model which are not expected to carry sudden loads, use light balsa that weighs from 6 to

9 lb. per cubic foot, Spars, longerons, stringers, struts, and all parts expected to be highly stressed should be made from stock weighing from 10 to 15 lb. The grading from light to heavy, in each individual category, should be governed by the size and weight of the model.

It may be helpful to know that the texture of the balsa varies from pithlike at 4 lb. to almost hardwood characteristics at 20 lb. The transition period seems to be around 9 lb. That is, balsa below this figure will tend to "snap" when overloaded, and stock above this number will tend to "kink" or break like hardwood,

Not only weight, but quality is important. Balsa having intermixed hard and soft growth spots, dry rot, or wind shakes should be used only for shaping and carving. Stock that has deep scratches or saw marks should be sanded smooth. Cuts have a tendency to concentrate the entire load at their points and so break before the general overload is reached. It is also poor practice to finish a job with coarse sandpaper. Such paper breaks up the surface fibers and pro-



Airplanes

duces deep grooves. After rough sanding, follow up with the finest grade you have. A glass-smooth, saw-cut surface is best.

Workmanship. Use sharp knives and razors, Dull edges will tear fibers and produce ragged ends. One secret of fine workmanship is to use light and generously sized balss, wherever curve cutting and shaping are needed.

With hard stocks there is a tendency for the razor to follow the grain instead of the template. Also, thicker but light sheet stock allows generous use of fine sandpaper when removing the rough and high spots. Thin sheets, which tend to sag between supports, allow very little sanding, and the wood must be left in natural state.

Wherever balsa is exposed to handling or weather, it should be treated with model dope or a similar liquid. The specific methods for finishing balsa under various conditions are as follows:

Thin Balsa Sheets. Ordinary dope will warp unsupported light sheets (all-balsa wings and tails) unless it is treated with castor oil to make it flexible. Add about ten

drops per ounce of dope. Mix well and allow to settle for several hours. Apply on a test sheet. If it still warps, add more oil; and if it remains tacky after an hour, add more dope. Apply two coats, and sand after each with 10-0 sandpaper.

Natural Finish for Thick Balsa, (Motor sticks, glider fuselages, propellers, and other thick baisa parts.) Apply several coats of straight dope with in-between sandings with 10-0 paper. To obtain an extra-strong skin like celluloid, add cement to dope. Use four coats with 10-0 sanding after the first two, and use wet 320 or 360 waterproof silicon-carbide paper on the last two coats. Ordinary sandpaper will clog up with thick dope-cement particles; nevertheless, the wet type of sanding cannot be used until the balsa has been well waterproofed by the early coats of dope. When waterproof paper is used in wet condition, it keeps its abrasive qualities much longer. For a fine finish, rub down the surface with a rubbing compound and polish with wax.

Color Doping. (Solid models, boats, and other display items.) Apply one coat of clear dope. This will close the pores or grain trenches, but it will not fill them. It merely prepares the surface for wood filler. The function of the wood filler is to form a sandable skin on the balsa contour. Sanding removes the filler from the high spots and leaves it in the valleys. So porous a wood needs several layers to do the filling effectively. Use filler prepared for balsa.

Regular colored dope or several layers of dope-and-cement mixture may be used as a filler, but it will require more work for good results. Sand the first two layers of filler with sandpaper until the balsa surface is reached at the high spots. Add two more coats. Then use wet \$20 or \$60 paper. Be careful not to use it on exposed and unprotected balsa as it will produce blisters and cause delay until it dries. When the surface is filled sufficiently to have an unbroken look, it is ready for doping.

For best results use thin color dope and apply it with a soft sable brush. Apply a coat and wait for about an hour before brushing on the second. Now wait for three hours before you smooth it with wet 400 paper. If the work must be extra fine and rich, add more coats with in-between sanding. Do not start too soon with the dope because it sets slower than the filler; and do not work too briskly or the friction might heat the dope and allow it to be rubbed away.

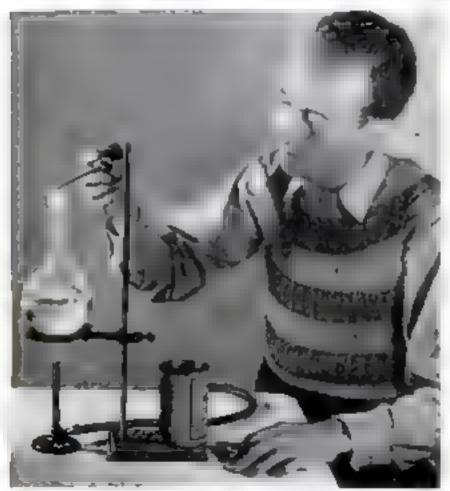
After the job has been completed to your satisfaction, one or two coats of banana oil will provide a high gloss, which may be toned down to a more artistic "used" look with rubbing compound and wax.

SCIENCE

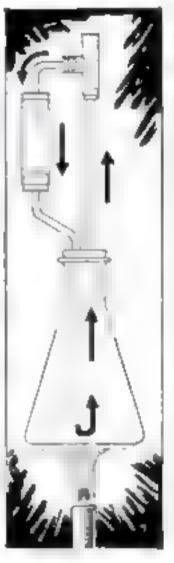
ITH homemade models, or the simplest of chemical glassware, you can learn as much about heating plants in a few minutes as might take several seasons of costly experience. Principles illustrated in these five easy experiments explain the "why" of important points in regulating and caring for a furnace or boiler. Ignorance isn't bliss on a cold winter day, for even the best heating system can perform only as well as its owner tends it. By understanding the way that it works—which will turn out to be surprisingly simple after all—he can assure himself during the cold months of a maximum of comfort and a minimum of fuel cost.



Colored water circulates in model hat-water plant



Water containing oil is slower in coming to a boil

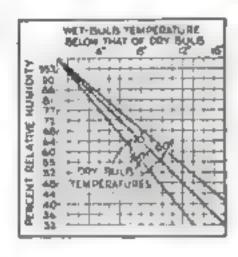


HEATING WITH HOT WATER. For the model heating plant shown, a flask will serve as a boiler, a large tube as a radiator, a T tube open at its top as an expansion tank, and connecting tubing as piping. Fill the flask with colored water, and the rest of the aystem with clear water. Heat the flask with a Bunsen burner. As the heated water expands, it gets lighter and rises to the T tube. Then, cooling, it descends through the "radistor" and finally returns to the "boiler," completing its round. Coloring the contents of the flask makes it possible to follow the path of the hot water in its course around the miniature set-up.

OIL IN WATER WASTES FUEL Put some pure water in a flask, and bring it to a boil. Note with a watch exactly how much time this requires. Now try the same experiment with an equal quantity of water, to which you have added a few drops of oil. This time the water will take considerably longer to boil. Moreover, a higher flame beneath the flask will be needed to keep the contents boiling. The reason is that the film of oil upon the water increases the surface tension, making it more difficult to turn the water into steam. Similarly, new heating systems often waste fuel because of the presence of oil in pipes, radiators, and boiler tubes. In order to remove the oil, the boiler must be "blown"that is, emptied of water through a blow-off pipe while under steam pressure. Or a special compound may be added to the boiler water, which then is drained and replaced with fresh water. Care must be taken, however, not to drain the boiler when there is a hot fire in the firebox, otherwise the boiler may be damaged.

SOOT ADDS TO FUEL BILL. Place a beaker containing a measured quantity of water upon a clean piece of sheet iron, and set the iron over a flame. Note the exact time it takes the water to come to a boil. Then coat the under side of the iron plate with a thick layer of soot, by leaving it for some time over a yellow gas flame. Using this plate, repeat the first experiment. You will find that it takes a longer time to bring the water to a boil, since the black coating acts as an insulator against the passage of heat. Innocent-looking soot in furnace flues acts in exactly the same way. Careful tests by heating engineers prove that a coating of soot only an eighth of an inch thick may mean a fuel loss of as much as twenty-nve percent. It may be seen from this that cleaning the flues at proper intervals will result in a definite saving on the winter's fuel bill.

rest for humidity. Being comfortable in your home, during the winter, involves not only the temperature but also the amount of moisture in the air—the relative humidity. To test it, note the reading of a thermometer; then wrap the thermometer bulb



in wet cotton and hold it in the breeze of a fan. The thermometer reading will drop, to a level depending on the dryness of the air. When it has reached its lowest point, subtract the "wet-bulb" reading from the ordinary one. The accompanying graph will then show the relative humidity, which should be about forty percent, at seventy degrees, for health and comfort.

COFFEE-CAN FURNACE. Punch a few holes near the bottom of a can, to represent the ash-pit draft, and attach a tin tube for a chimney. With a candle for a fire, you have a heating plant in miniature, which can be observed through a window tightly covered with a



fire, you have a heating which can be observed tightly covered with a piece of mica. Obstruct the draft holes or chimney, and the "checked" flame burns dimly. A fan breeze over the chimney opening increases the draft and brightens the flame, as does a "forced draft" produced by pointing the fan at the lower holes. Deflecting a breeze from the chimney, as at right, reduces its effect.



A layer of soot on the metal plate delays heating



Taking a wet-bulb reading for relative humidity



How a building obstruction cuts draft from a breeze

TABLE-LAMP RADIO. Built into the bakelite base of this attractive table lamp is a five-tube radio receiver with a dynamic speaker. A knob controls the an-off switch, and tuning is accomplished by turning the revolving dial in the base with the tips of the fingers

RADIO

JEWEL PICK-UP NEEDLE

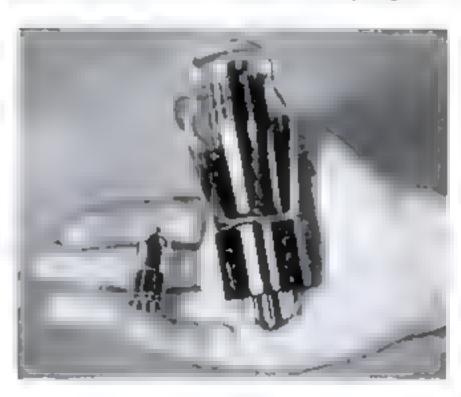
The new crystal pick-up below has a permanent jewel stylus of fine sapphire that is said to lost a lifetime. The stylus is guarded by a spring mounting (indicated by the pencil in the photograph) which prevents horm if the pick-up arm is dropped





CABINET TOUCH-UP KIT. Six different shades of high-grade lacquer are supplied in a handy ket for touching up plastic and colored cobinets. The colors are walnut, ivory, black, red, blue, and green. Bottles holding the enamel have plastic tops with attached brushes for applying it to cabinets

TINIEST RADIO TUBE is the 14-inch midget shown below in contrast with a standard-size tube. Its plate-current drain is so low that it cannot be measured on a milliammeter! These tubes are available with tinned leads, or with a five-prong base



IDEAS

HEAT-RADIATING TUBE CON-NECTOR. Designed to protect the glass seals of transmitting tubes from damage by overheating, connectors of a new type are fitted with vanes that give additional surface for heat radiation. The connectors are available in four different sizes





PICK-UP FOR DANCERS' SHOES. Amplifying the taps in tap dancing is a new job for pick-up units of the type commonly used on musical instruments. In the photograph above, the song-and-dance team of Valley and Lynne have the units attached to their insteps

RECORD CHANGER. Any radio becomes an automatic phonograph when used with the instrument shown below. Requiring no connection with the radio, it plays eight ten-inch or seven twelve-inch records without attention





PERSONAL RADIO. Opening the lid of this compact portable radio turns it on automatically. The built-in antenna brings in broadcasts from stations fifty or more miles away. Its small size, light weight, and economical power requirements make it ideal for outings and travel



SUMMER-WINTER RADIO

One radio takes the place of two. The polished walnut table model works on house current. Placed in a sport case, it becomes a battery-powered portable

ARRIED outdoors, the compact fourtube superheterodyne receiver
shown at the top of the page is a
sporty, summertime portable radio,
finished in striped sirplane-luggage canvas,
and powered by batteries. But it takes a second look at the highly polished walnut tablemodel radio in the lower picture to be convinced that it is the same set, stripped of its
sport clothes and formally dressed for wintertime use in your living room. As a table
model, it is powered by house current, either
alternating or direct.

The secret behind this all-season radio lies in the construction of a canvas-covered

outer wooden cabinet, with a carrying handie and space for a battery pack, into which the walnut-finished main cabinet can be slipped. A handy plug connector simplifies attaching the batteries, replacing the power cord used for house-current operation. Dimensions for making the cabinets are given in the accompanying drawings.

The set's circuit uses a 1A7GT tube which serves as the combined second detector, automatic volume control, and first audio tube. A 1A5GT (Continued on page 227)

By ARTHUR C. MILLER

LIST OF PARTS

Electrolytic condensers: 40 mfd., 150 volt; 24 mfd., 150 volt; 12 mfd., 150 volt; 100 mfd., 50 volt.

Tubular condensers: 06 mfd., 200 volt; .005 mfd., 400 volt (two); .01 mfd., 600 volt (three); and .1 mfd., 600 volt (two).

Mica condensers, .00005 mfd., and .0001 mfd

Adjustable resistor, 10 watt, 2500 ohm.

Volume control, 1 meg Carbon resistors: 1 watt, 3,500 ohm; ½ watt, 1 meg. (two); ½ watt, 50,000 ohm; ½ watt, 70.-000 ohm; ½ watt, 10 meg. (two); ½ watt, 2 meg.; 1 watt, 2,000 ohm.; and ½ watt, 800 ohm

Input IF. transformer, 455 kc. Output, 455 kc. Oscillator coil, 455 kc. Padding condenser, .00035 mfd.

Tuning condenser, 2 gang, .00036 mfd.

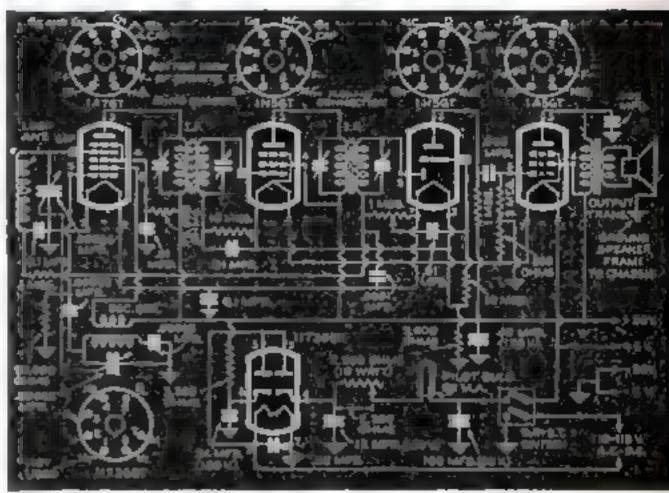
P M. speaker.

Universal output trans-

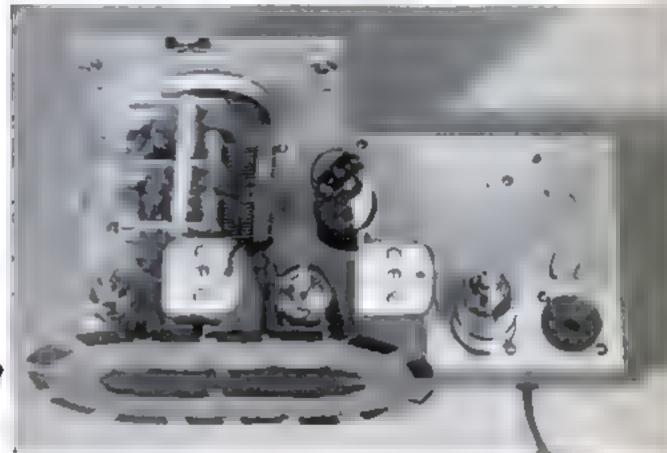
Speaker plug, battery cable, wafer socket, power cord, octal sockets, loop antenna, tubes, switch.



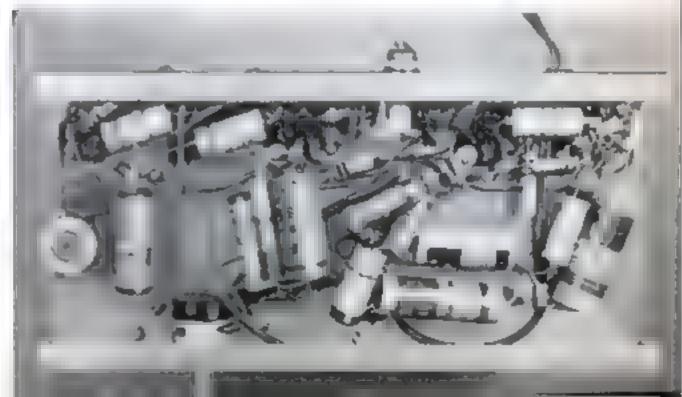
All details of the circuit are given here. Note that it is a fivetube set on house current, but a four-tube one when battery powered



How the parts are arranged on top of the chassis. The grouping a lows plenty of space for the loudspeaker mounted an the front panel



Use extreme care when soldering connections below the chass's



PHORAPHY

"Cotter Pin Locomotive"

"Pictures While I Walk"

Popular Science Interviews Photographer Harald Harvey

AROLD HARVEY has built himself a highly satisfactory life on three careers and a hobby.

He began as an artist and illustrator, became one of the country's best-known commercial photographers, and turned from that to an even more brilliant success in photographic research; his best-known accomplishment thus far being the Panthermic 777

film developer, presented commercially three years ago. The hobby, however, has remained constant. Harvey has been taking photographs for thirty years, and although he never has time for commercial assignments any more, he hasn't stopped making pictures.

Every day of decent weather, the year around, Harvey emerges from his laboratory-apartment in uptown New York and



"Impressive Building Pattern"

conscientiously roves the section for exercise and fresh air. Invariably he drops a
camera or two into his capacious pockets.
The walk usually lasts an hour, and Harvey
may take five pictures or five rolls. Most of
these will be made for purely technical
reasons—to check practical results against
lab findings, or the cutting quality of a new
lens. But Harvey's approach to photography is not altogether a matter of science—



"Amusing Contrast"



"It Pîles Up"

he looks for humor, human interest, and pictorial quality as well.

And what does this photographic scientist shoot when he takes one of his camera walks? Well, take an imaginary stroll with him, looking over rough prints in his file and asking the simple question, "Why did you take that?" Here are the answers which explain why he felt impelled to make the vari-

ous pictures that accompany this story.

Cotter-Pin Locomotive: "That's the sort of thing we were doing ten years ago. Just an old locomotive over in the yards, but it made a composition. The texture is good—and to tell the truth, it fascinated me to see that locomotive wheels have cotter pins, too."

Impressive Building Pattern: "The great Cathedral of St. John the Divine has endless photographic possibilities. I love to study its architectural details. This is simply an impressive building pattern."

Amusing Contrast: "That was an amusing contrast—a pretty girl and the grinning face of Pan—sort of a Pan and Superpan."

It Piles Up: "That's just an ornament over at Columbia University. It piles up—makes a nice composition."

Small-Town Street: "That walk was in a town in West Virginia where I wandered last summer. The sleeping dog, the old man sitting there—they just added up to a perfect picture of a quiet, hot day on a small-town street."

Resolution of Detail: "That's a test shot I make every time I go by it. I find it useful as a gauge subject for negative grain-iness—the lines in the pillars won't show if the grain is just a bit too coarse."

Like many another topnotcher in pho-



Horvey shoots skyward at a cathedral buttress

tography, Harvey began his training as an artist. Baltimore was his home town, and he studied art there, at the Pennsylvania Academy in Philadelphia, then in Paris—about eight years in all. He began using a camera to make records of street scenes and architectural details.

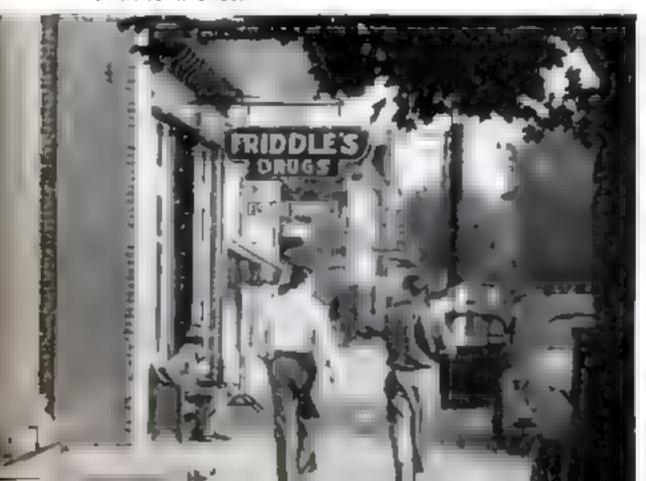
Gradually his interest in photography, both as an art medium and a science, altered his earlier plans. By 1930 he was back in

New York, a star photographer in the advertising field. He was retained on the Chesterfield account for three years, and is said to have been the first man to use a miniature camera (35-mm. film size) successfully for national ad pictures. His tiny negatives produced photos which were blown up to billboard size all over the country.

Harvey wasn't especially happy as a commercial photographer, but he made enough money at it to finance his first experiments in the complex chemistry and physics of photography. He had some training in chemistry, but there was a lot to learn, and it was not until five years ago that he was able to put all his time into research.

Harvey swears by—not at—the miniature camera, and uses it for anything from land-scapes or air views to microscope work. He uses four Leicas and two Contaxes, and that is not because he is a gadget-lover, either. Each camera is used with a specific lens, and Harvey will not interchange his lenses. He works to a degree of precision far beyond that wanted or needed by most photographers, and the very small tolerances provided by the camera manufacturers are much too big to suit him. Each of his tiny cameras has been carefully checked and adjusted, each lens and range finder registering with the precision of a fine microscope.

"Small-Town Street"





Try Type for Movie Titles

OOD taste is the essence of titling amateur movies successfully. Titles must be planned and executed carefully if the final film is to present a workmanlike appearance approaching the professional. A small printing press, the cost of which is comparatively little, provides one of the best methods of making titles.

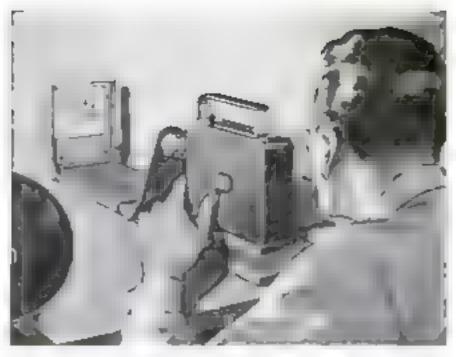
For white letters on black backgrounds, use positive film and print the titles in black on white cards having a rough or matte surface. You can develop the film yourself

very easily.

If, however, you wish to use reversal film, don't try white printer's ink on black paper—the letters will not be clean cut. Instead, print with colorless varnish, then dust the title with silver or white powder while it is still tacky. Another method is to print black letters on transparent cellulose tissue, and use the tissue as a negative to make a photographic print. If photographs or magazine illustrations are to be used as backgrounds, reversal film is required, of course.

Whenever possible choose a type font for the opening title that helps to convey the idea expressed. Several examples are given at the right. Special fonts can often be borrowed from a local printer, or may be purchased secondhand for very little.

Most small commercial titlers for 16mm, movies permit photographing a card of the size shown at the bottom of this page. When such a titler is used, the letters of the lead title should seldom be



For low-cost titles, use positive film. Tonal values are reversed when the film is developed

more than 24-point size (approximately 5/16" high). Explanatory titles throughout a film can be set in 14-point type (approximately 1/4") or a little larger. Choose a font of straight, clear type for these titles. Fancy types have no place in the average film except at the beginning and possibly at the end.—John H. Wood.



Neuland



Barnum



Phoniz



Bernhard Cursive Bold



The title at left may be used in any of the small commercial titlers. Below, a hand press suitable for printing titles



Chaplin of Still Pictures

By JOHN H. WALKER

O PROBLEM in photography is tougher than that of turning out funny pictures consistently.

Lejaren a Hiller, one of the greatest commercial photographic illustrators, has made something of a specialty of humor, achieving brilliant results in a field that most commercial men avoid or neglect. He has two guiding principles for the job:

1. Don't tackle a humorous photographic subject

unless you are really in the mood for itfeeling well and reasonably happy.

Unless a ready-made situation or subject presents itself, you are apt to get the best results by using yourself as a model.

"You can't force humor," Hiller explains.
"It's got to be spontaneous. Humor in photographs usually must involve human beings, and that's where you run into trouble with models. It's hard for them to be spon-



Lejaren a Hiller, master of the lens, is his own model in his most humorous shots. He made this one originally for a Christmas card

taneous under the strong lights, with a lot of make-up on.

"The average model is a clother rack—no expression at all. And 'acting' isn't much good. Nine times out of ten it looks phony in a still picture. You have to try to make the model actually feel the emotion you want to show—or something close to it.

"Sometimes I have to deliberately annoy a model, to get the proper angry expression.

WIN \$25

with your

FUNNIEST PHOTO Do you have a funny photo that starts the chuckies rolling among your friends? You probably do, and that's why we are offering a prize of \$25 for the funniest photograph we receive from our readers before January 15, 1941. Dig into your file now . . . bring out your most laughprovoking photo . . . and mail it to Photo Editor, Popular Science, 353 Fourth Avenue, New York, N. Y.

Any subject, so long as it's funny, will fill the bill. Limit your print size to 8" by 10". Single-weight, glossy paper preferred. No photos returned. Editors' decision is final, to case of a tie, duplicate prizes will be awarded.

Or, if you want him to have a quizzical look, you can mumble instructions that he won't quite understand, and then catch the picture when he turns and strains his ears and wrinkles up his brow, trying to figure out what that dope over at the camera is saying."

In other words, when you set up and direct that kind of picture, you have to be an actor yourself. And Hiller has found that some effects can be obtained only when you step into the picture and become your own model. In a big studio, of course, he can line up his picture and give the signal for an assistant to make the exposure. An amateur photographer can do the trick with a long extension cable release: a little practice will enable him to conceal the cable and keep it out of camera range.

And what are the principles for self-modeling? In the first place, Hiller reiterates that you have to feel like doing this at the time. Second, try to do as little pretending as possible. If the picture is to show you drinking from a cup, have some water or tea and really drink it. (Naturally, this technique is conditioned by the length of the camera exposure, unless you are taking movies.)

Third, use the technique of exaggeration, but use it with care. If you want to look annoyed or startled, try to feel that way, then pour on the expression a bit more. (Americans cultivate the polite habit of concealing emotion, and most of us develop better poker faces than we realize.)

The lighting of your picture can make a tremendous difference, and Hiller says it seems to follow a law of gravity—down lighting tends to direct the mood of the picture down, to make it softer and quieter in feeling, while bright lighting from below pushes the picture up, gives it a mood of greater brilliance and lift.

How much the photographer's spontaneous mood can have to do with a picture is well shown by one of Hiller's latest and greatest humorous photos. It



COLUMN OF GRASHAL KARLTHU

Skillfully chosen accessories help a lot, or in this case where Hiller enacts the part of a disconsolate horn player

Although his face is actually rather mild and dignified, he has learned how to contact it into a variety of "mugs"



represents an old-style stage magician having his troubles with card tricks and egg tricks. This picture is being widely used as an advertisement and is regarded by expert photographers as a classic of its type.

The atory behind it is that Hiller never made that picture as a commercial job. He knocked it off for his own amusement, planning and modeling the pose himself, to be used as a family Christmas card. Friends in the advertising business saw the card and fell in love with the picture.

"A man making faces is one of the oldest and surest bits of humor in the world," Hiller explains, "and it helps a lot if you have a funny mug to begin with."

His own "mug" isn't naturally funny—you'd describe him rather as mild and dignified. But it is highly mobile. He can twist, wrinkle, and grin, His iron-gray hair can be plastered down for effect, and he is gifted with a moderately long nose which a

little make-up and a skillfully planned high light can transform into a regular W. C. Fields-Jimmy Durante achnozzola.

Just when Hiller began making funny faces on a serious scale he can't remember. He suspects it all dates back to a brief, stage-struck experience years ago.

Hiller's family originally came from southern France. He was born in Milwaukee (nearly sixty years ago, although he doesn't look it). He started out to be an artist, and still paints in the backgrounds of the elaborate sets against which many of his advertising illustrations are shot.

Early in the game, however, he became fascinated with the possibilities of the camera and helped pioneer the modern art of illustrative photography. He has been rated a top-notch photographer for more than thirty years, and is credited with being the first man to use the camera successfully in illustrating magazine fiction.

He is vice-president of the Underwood &

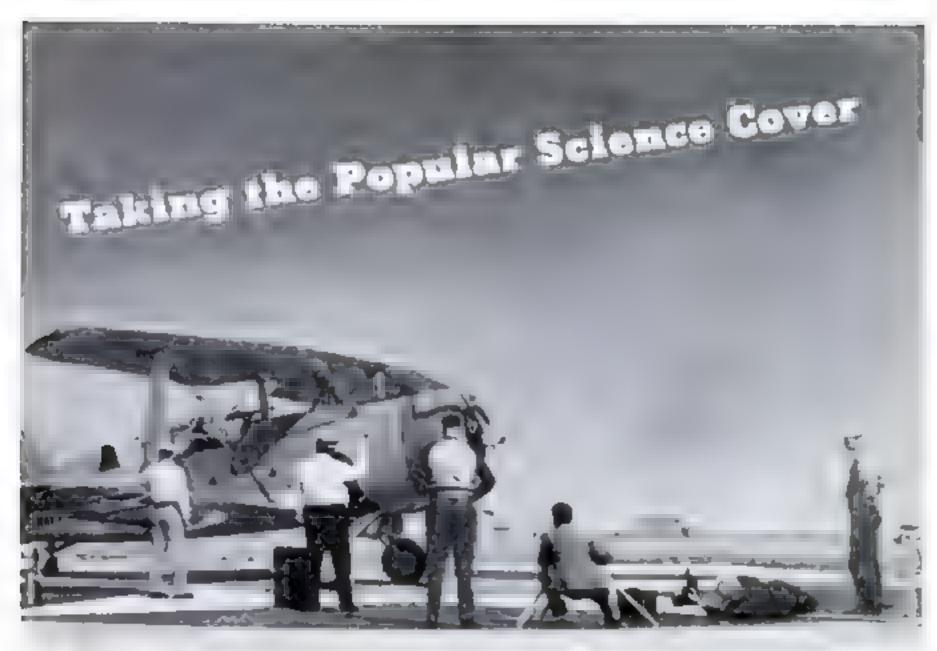


"A man making faces," Hiller says, "is one of the oldest and surest bits of humor." In this example the mood is helped by down lighting

Underwood agency, and works in a crowded, barnlike studio not unlike a movie set, near the East River in midtown New York.

Hiller claims every man should try to have two jobs—to carry a spare profession, you might say, in case one goes flat. His own extra job is writing.

Some of his current photographic jobs are so complex that he considers them problems in applied science rather than photography. On a recent job, for example, he had to show a native riding a speeding surfboard on the crest of a blue wave. Three chemical companies were consulted in an effort to develop something that would look like white sea foam but stand up long enough to be photographed under power lights. In the end Hiller solved the problem himself by mixing salt with fire-extinguisher foam; the foam itself disappeared, but left the outer coating of salt in place. It was still there, looking fine, when they knocked the set down a week later.



IDDAY sunlight and three shrewdly placed blue flash lamps gave William W. Morris, Popular Science staff photographer, just the illumination he needed for the full-color picture of the Curtiss dive bomber SBC-4 reproduced on this month's cover. He had to stretch full length on the ground and shoot with a one-arm grip on his 4" by 5" Speed Graphic.

The photograph of this training dive bomber was taken at the Floyd Bennett Field Naval Reserve Base, Brooklyn, N. Y. The exposure was made on daylight Kodachrome-f/11 at 1/25 second. An Abbey flash gun, with two tandems or photofiash extensions, was used. There was one bulb at the camera to illuminate underneath the cowling. Another was held by Editor Charles McLendon so as to throw light on the yellow strip under the upper wing and on the face of the pilot, Lieutenant-Commander Don F. Smith, U.S.N. (in circle). The third lamp was clamped to a camera case where it would lighten the underside of the fuselage. Twelve



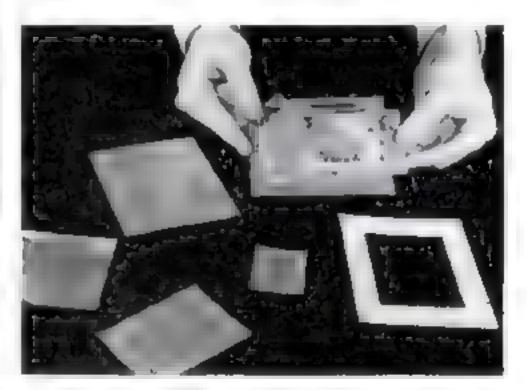
shots were made from various angles, and a crew of Navy mechanics shifted the plane around as required for the best lighting and background effects.

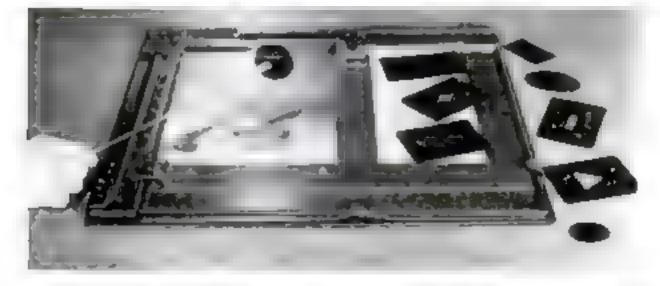
Photographer Morris has had wide experience in such work. He was in charge of photography at the New York World's Fair, 1939 and 1940, and was formerly chief publicity photographer, United States Navy, where he served from 1915 to 1923.

EXPOSURE-METER BRACKET. Using an exposure meter and a comers at the same time is made easy by a metal bracket which is attached to the tripod socket of the comera and holds the exposure meter securely in position

DEVICES FOR

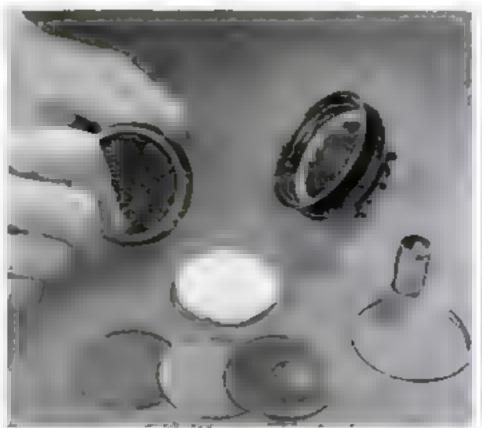
FRAMES KEEP PICTURES CLEAN. Fitted with windows of transparent cellulose acetate, the frames shown below protect photographs mounted in an album, Backs of the frames are gummed for attacking to album pages. Mode in several sizes, they may also be used for preserving stamps, newspaper clippings, and other display material

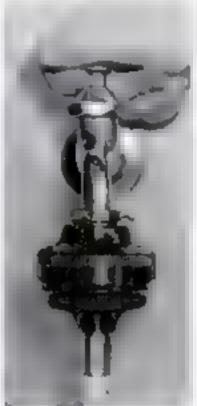




ENLARGER DODGER. Here is a versatile dodger for the amateur who does his own enlarging. A wire handle with a small clamp on its tip holds any one of nine pieces of red callulaid which cover a wide range of sizes and shapes, including circles, ellipses, oblongs, and squares. Several of the pieces have hales in their centers for "burning in"

WATER FILTER, Made specially for use in the darkroom, the filtering device seen at the right con be attached to any foucet. Its parts, shown in the first photograph, include several screens and a filter disk made of ce lulose fiber. When the filter disk becomes foul as the result of use, it can be cleaned by placing it in a bottle of clear water and shaking it vigprously, then pouring the water off with a strainer





PHOTOGRAPHY

CAMERA USERS

CORNER CUTTER With this took the amateur can mount a photograph quickly in an album without using gummed corners or paste. The print is placed in the desired position on the album page and a corner is inserted in a slot in the cutter. By pressing the handle, the two slits are cut in the page



TRAY CLEANER, Stains are removed from developing trays, glass printing frames, and other darkroom equipment by a cleaning preparation in paste form. The cleaner is applied with a damp cloth, after which the article is rinsed off and allowed to dry





PANCHROMATIC MAKE-UP KIT. Specially created to reduce the need for retauching in black-and-white portraits, panchromatic cosmetics are available in handy stick form in a kit containing five shades of complexion foundation, three shades of powder, lip rouge, eyebrow pencil, and eye shadow

TRIPOD AND NECK POD are combined in the accessory shown at the right. The camera is screwed onto the end of a rad which can be either supported on three legs as a table-top tripad, as seen in the first photograph, or hung around the neck by the strap attached to its lower end. When fully extended, the tripod is eighteen inches long, but it folds into a compact bundle measuring about ten inches over all. The tripad head is adjustable. For convenience, the strap can be removed by taking out the knurled screw that holds it in place. When used as a neck pad, the device gives a threeway camera-steadying effect









Two pictures taken from the same
place with the
same camero, one
with the camplete
lens, the other
(right-hand view)
with the front
lens cell alane

Five Lenses in One

BY ARTHUR TRAUFFER

F YOU can pick up a secondhand anastigmat lens of the symmetrical, four-element, air-spaced type* or salvage one from some old camera, you can have a lot of fun experimenting with it. Mounted in a camera with ground glass and double or triple extension bellows, it will serve as a makeshift convertible lens of five different focal lengths.

Completely assembled, as intended by the manufacturer, the lens is suitable for regular work. The front and rear cells, used separately, provide two different long-focus lenses that give large images of distant objects. In addition, the front and the rear positive elements—that is, the convex elements—form separate short-focus lenses for making greatly enlarged copies (macrophotography). Thus there are one ordinary, two long-focus, and two short-focus lenses.

It goes without saying that a single cell or a single element is subject to optical aberrations and must, be stopped down sharply. It will also be found that the speed of either cell, when used separately, will be considerably slower than the speed of the complete lens. All the illustrations were Because the four lens elements can be used separately or grouped, they act in a pinch as one ordinary, two long-focus, and two short-focus lenses



Magnified detail of a postage stamp obtained by using only the rear positive lens element

"A well known lens of this kind is the old Kodak Anastigmat (Eastman) series f 7 7 and 1/6.3 which is no longer made for hand Kodaks. Others are Cooke Avist, Goers Apochromat Artar, Goers Celor, Goers Dogmar, Goers Gotar, Goers Syntor, Graf Anastigmat, Gundlach (Unofocal type), Steinhell (Unofocal type), and Luxar.

made from a lens removed from an old 1/7.7 post-card size folding Kodak purchased secondhand for a few dollars. The focal length of the complete lens is 6½", and the parts are shown in a diagram above.

Photographic Paper Box

Photographers can save time in enlarging by keeping the projection paper in a light-tight, self-closing box or desk like the one illustrated. This makes it unnecessary to open several envelopes each time a sheet is needed. The box has two compartments each for 8" by 10" and 11" by 14" paper, as well as places for test strips. The design is such that the box may be used vertically or even acrewed to the wall if bench space is limited in the darkroom.

All the principal parts are cut from 4" plywood. Groove the sidepieces to receive the partitions, which are 4," fiber or pressed-wood board. Glue and nails are used to join the pieces together tightly enough to be lightproof. Block off the partitions with narrow strips of wood so that each compartment is slightly oversize for the paper it is to contain. The extra space is used for the test strips.

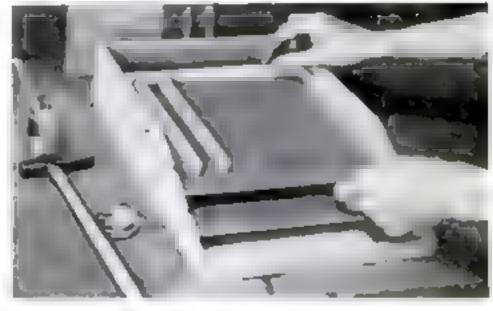
Fit the cover over the box and drill a small hole on each side in the lower back corner. Small roundhead screws pass through these holes into the box and act as pivots for the cover. To make the cover self-closing, a spring is used on each side. This is shaped from 1/16" piano wire by coiling it three times around the shank of the pivot screw and bending the ends at a right angle to fit into two holes, one

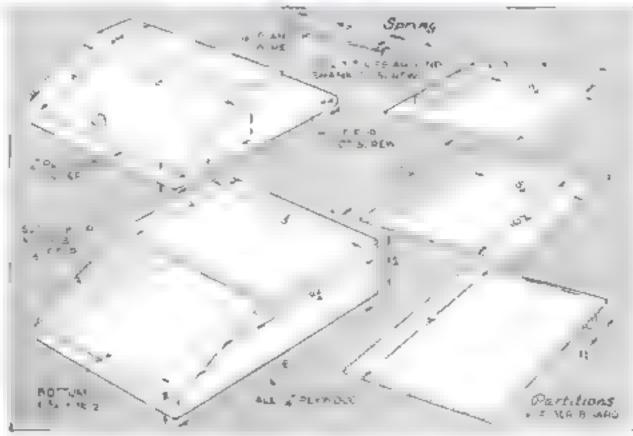
drilled into the cover, the other into the box.

As the grain in most plywood is attractive in itself, the only finish required on the outside is shellac and varnish. The accompanying photos were taken before the interior was painted, but as a precaution against any leakage of light around the cover it is advisable to give the inside a coat of flat black. Of course, the outside of the box may also be painted, if desired. Choose a serviceable color that will not reveal finger marks. -FRANK MCCARTY,





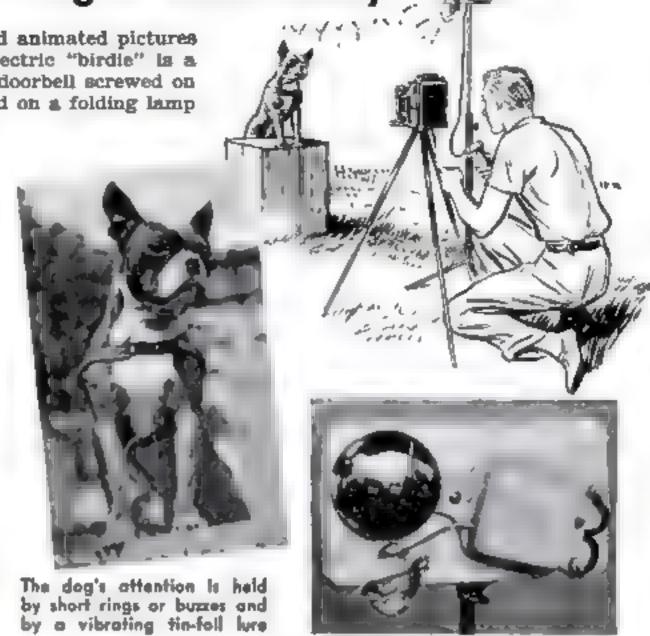




How to Get a Dog to Pose Alertly

OR taking more alert and animated pictures of your pet dog, this electric "birdle" is a great help. It consists of a doorbell screwed on a board that can be mounted on a folding lamp

stand. A tin-foil lure is hung on the gong hammer by means of a loose wire loop. Properly adjusted. the lure will climb up the vibrating hammer when the bell is rung, and then alide down when it is stopped. A buzzing sound instead of a ring can be obtained by cutting a notch in the rim of the gong and turning it so the hammer vibrates without striking the metal. A flash gun, connected to the bell by means of an extension cord, serves as a battery-andcompact switch unit. Short buzzes or rings, sparingly used to maintain curiosity, get the best attention-holding results.—J. M.





Simple Accounting System Keeps Track of Cut Film

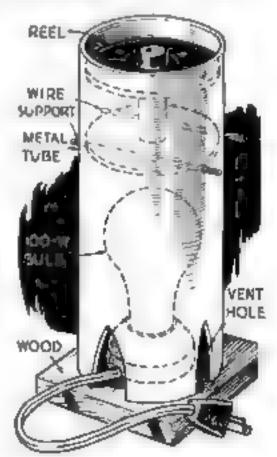
You will not run out of cut negatives unknowingly if you use the simple accounting system illustrated above. Each time you take one or more films from the box, subtract the number from the old balance and then mark the remainder on the margin of the box cover.

Wet Reel from a Roll-Film Tank Dries Quickly over an Electric Lamp

A SIMPLY made tank-reel drier will greatly increase the usefulness of your roll-film tank. You often want to start developing a second film while waiting for the first one to dry, yet cannot do so because it is impossible to thread the film if the reel is the least bit moist. The device shown is a

sheet-metal or heavy cardboard tube of sufficient size to permit the reel to slide down inside. To prevent the reel from slipping down too far, a pair of wires are inserted as shown, or any suitable form of support may be used. At the bottom of the tube, mounted on the baseboard, is a large electric lamp.

The empty film-tank reel will dry very quickly provided you shake as much water as possible from it before you place it in the tube.— RUSSELL J. HUNT.



New Delta ID Saw Is the People Tool

Designed after 7
years of study, research and experiment—7 years of
analyzing the defects
in existing designs
—of testing, re-testing—7 years of mak-

ing model after model—this new Delta 10° Tilting Arbor Saw is as near the perfect tool as modern engineering can make it. Thousands of users agree that it offers numerous exclusive advantages and an operating efficiency never before attained!

Here Are Some of the Features of This Remarkable Tilting Arbor Saw

Generous sized table 20" x 27"
(with wings, 27" x 36"). Handles
work up to 50" wide and 3%"
thick. Powerful, fully enclosed
motor; highly efficient Texrope
drive; rigid, scientifically designed
housing; perfected raising, lowering and tilting mechanism; patented, double-face, double-lock rip
gauge; exclusive precision auto-set
miter gauge; patented ripping extensions; "sealed-for-life" ball bearings
and many other features.

Send for Latest Delta Catalog

A complete guide book to power tools which not only lists the complete line of Delm "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. (Also send for Project Book No. 7 crowded with new projects, including working drawings, photographs and full instructions.)





but not for Delta machines! Precision grinding to size, after turning, is an extra operation. It costs more money—and you can t see it as you can see nickel plating on the outside of the machine. But in a bearing or bearing seats, it provides a fit that is "all over" instead of only on a comparatively few high spots. This means that ball bearings do not become loose in service. Precision grinding produces a closer fit, to more exacting tolerances, which means that fits are uniformly good, and that true interchangeability is obtained.

The extra occuracy obtained by precision grinding may be visualized when it is realized that the ordinary variation or tolerance on Delm arbors and spindles is three-ten-thousandths of an inch, and in many instances this tolerance is held to one ten-thousandth,

Before you buy any light machine tool, make sure all parts that vitally affect the accuracy and life of your machine, are precises ground to size!

DELTA MANUFACTURING COMPANY (Dopt. 2141)

600-634 E. Vienna Ave., Milwaukee, Win.

Gentlemen: Send me the latest Delta Catalog lating the complete one of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Supders and Drill Presses.

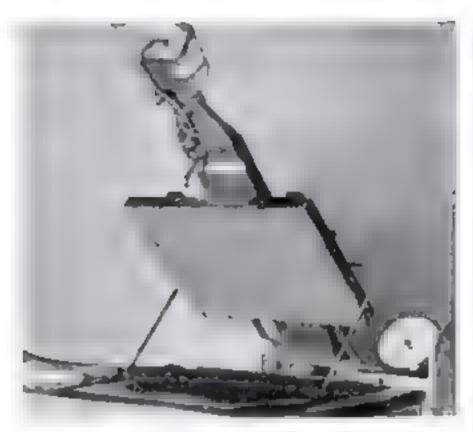
I enclose 10c (stamps or com) for which please send me the new Delta Project Book No. 7

Name

4 ddress

Copy J Check here if you are a Pelta user now.

State



Sponge Rubber Pad on Printer **Furnishes Perfect Contact**

Do you have trouble in pressing your photo prints in perfect contact against the negative in your printer? If so, remove the old padding from the printer head and replace it with a sheet of sponge rubber ¼" thick. Use casein glue because the heat from the printer lights might soften other adhesives, such as rubber cement. Use a steel brush or sandpaper to clean both surfaces and wipe off the dust before gluing. Leave the printer head under a weight overnight for the glue to set.

Rule 4 " squares on the rubber with 44" spaces between them. With a sharp safety razor blade, cut along the 1/4" lines between the squares and remove the %" strips. The spaces thus provided allow the squares to spread easily and make contact with the negative and mask when the printer head is

depressed.—R. D. MURPHY.

Removable Labels for Bottles



PHOTO chemical bottles are more easily labeled if the name or number of the formula is lettered on a square of white double-weight paper and fastened to the bottle or jug with a rubber band cut from an old inner tube. Such a label is easily read, and it can be removed when the bottle is to be washed. The date on which the formula was mixed can also be written on the label.



DEALER presents five Holiday Headliners

KODAK MONITOR SIX-16

(Special f/4.5) Supermetic Shyster

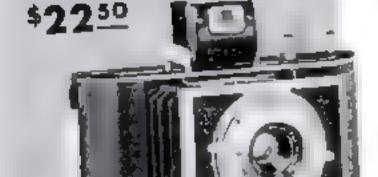
One of the greatest cameras for 215 x 414 inch pictures. Kodak Anastigmat Special / 4.5 lens; 1 400-second Supermatic shutter Double-exposure prevention. Film-centering device. Exposure counter.



KODAK VIGILANT SIX-16 (Special f/4.5) Supermatic Shutter

An instant hit-with self-erecting front, retracting body shutter release, two view finders. Precise Kodak Anastigmat f 4.5 Special lens, 1. 400-second high-speed Supermatic shutter. Pictures, 24 x 44 inches.





KODAK BANTAM 5/4.5

Gives you the speed and precision of the Kodsk Anastigmat Special f.4.5 lens, 1/200-second shutter. Modern photofinishing methods lead to black-and-white pictures 24 x 4 inches. Also takes full-color Kodachrome Film.

Kodaks from \$3.95; Ciné-Kodaks from \$29.50. At your dealer's . . . Eastman Kodak Company, Rachester, N. Y.

Only EASTMAN makes the KODAK



"YANKEE" TOOLS

make better mechanics

North Bros. Mfg. Co., Philadelphia, U.S.A.



Easily Assembled Magnifier Aids Ground-Glass Focusing

ASSEMBLED in a few minutes, this magnifier aids in accurate ground-glass focusing. The upper and lower hoods are cut from an old inner tube, and the magnifying glass is from a cheap pocket magnifier.

Draw a paper pattern for the two hoods, which are identical, and cut the rubber to match. Fasten the edges of the cones with rubber cement. A reënforcing strip of inner

ABOUT
LENS
TO GROUND
GLASS

CIRCUMPERENCE:

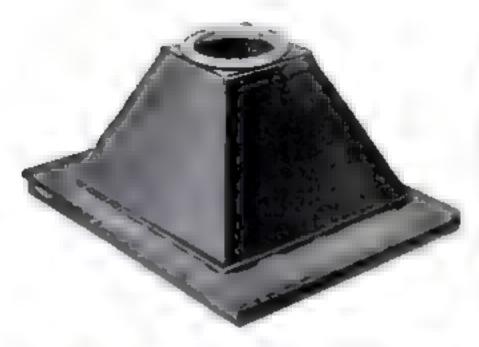
tube about %" wide is then cemented to the inside of each of the seams.

The cones are finally cemented together at their small ends, and the magnifying glass is cemented in place. It can be made more secure by cementing a narrow strip of inner tube above and below it inside the two cones.

—ROBERT SCOTT.

Spilled Hypo Causes Injurious Dust

When developing in the darkroom, always be careful not to splash any hypo solution on the floor. Hypo dust may result when the water evaporates, and cause spots on sensitized materials.



Short-Focus Lens from Camera Adapted for Use in Enlarger

I WISHED to use the 3" lens from my miniature camera as a projection lens in my 5" by 7" enlarger, but discovered that the bellows would not rack close enough to the negative carrier. An adapter made from discarded film-pack backs solved the problem. Cardboard patterns were cut to obtain the proper size, and allowance was made for folding over on the edges. A lens flange was purchased from a camera supply house and soldered in place. The possibility of light leaks around the edges of the adapter where it fastens to the lens board was eliminated by the application of auto-top patching material, which was flowed into the joint. A coat of dull black paint finished the job.

The use of this adapter enables me to project to 12" by 18" from a double-frame 35-mm, negative. No dimensions are given, as these would vary with the focal length of the lens and the shape of the lens board of your enlarger.—BRUCE BORNHOLT.

Pinholes in Small Negatives Removed by Double Spotting

PINHOLES in small negatives, caused by dust particles, are rather difficult to opaque and often necessitate considerable spotting on the enlargements. After placing the paper in the enlarging easel, drop the red filter safe light in position and turn on the current so that the pinhole spots are visible. Carefully apply soft lead pencil to these spots. Remove the filter safe light, make the exposure, and develop in the usual way. The lead penciling may be rubbed from the print while it is in the hypo or erased after the print is dry. The spots will appear white and can be eliminated by careful spotting. This is much easier than trying to remove black dots with opaque retouching paint or an etching knife.



THE vant differences in file-tooth construction, as indicated by the four files above, show the importance of selecting the right file for the job. Example: For the brass-filing job pictured here, the specially designed Nicholson Brass file is being used . . . because its short-angle upout teeth prevent the file running off the work and keep the file clear of chips, while the long-angle overcut breaks up the filings.

NICHOLSON FILE CO., Providence, R. L. U. S. A.

(Alm Canadian Plant, Port Hope, Ont.)

FILES

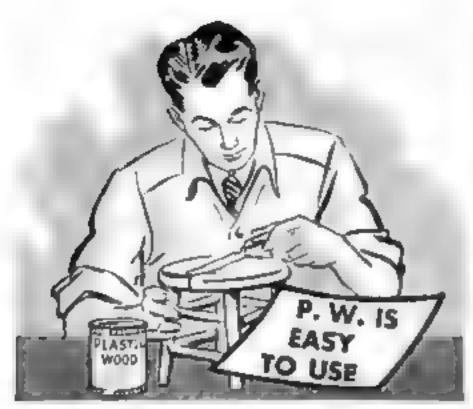
NICHOLSON FILE

FOR EVERY PURPOSE

SEND FOR any of the interesting items of file information listed in coupon below (check once wanted).

MICHOLSON FILE CO., 19 Acors St., Providence, R. J., U.S.	l. A.
Send me 🗆 Fron book, "A File for Every Purpose." To	-do-
meal Bulletin on files for 🗌 Brass 🗎 Aluminum 🔲 Fo	
dry Castings 🗆 Die Castings 🗈 Lathe Filing 🗔 Die	and
Model Making (X. F. Swim Pattern).	

Name_				



P. W. REPAIRS FURNITURE

Plastic Wood handles like putty-hardens into lasting wood. Makes quick, yet perma-

ment repairs to broken furniture, resets loose drawer pulls and casters. In cases or tubes at Paint. Hardware, 10# Stores.







serve et tete with Has officed hom on ybdoneedaring ture vi en an ess 110 y antversa AC Dr 1 han bull-tola cooling lea.

6 se Madet I Moto Tool reimplete with chink and the collett on y BD 85 Masser Mode 2 faster. heatler more powerful w b chuck and la" col-let only \$18.50

10-DAY MOMEN TRIAL

Ree gran ne Dremel Moto-Tools and complete h and he ter des ers or order d red from factory on tilpret from factory on the day manney took trial for only \$5.00 with order West, p. C. O. D. for balance. Send

Modern Craftsmap's 1770 E P No. 1 with 23 high prode security and Model I Mote-E F v 2 to F 18 2 to F 18 Tr. 4 523.50 11 DREMEL MFQ. CO., Dept. T-121-A, Racine, Wis.



MODEL



Full-Size Blueprints for Building Models

HEN you build a ship model, full-size blueprints are of inestimable help. You can take dimensions right off the drawings and compare the completed parts directly with them in respect to size and shape. Plans are available for about fifty different models.

We also have blueprints drawn to scale for many other projects. A few of them are listed below. Our complete list will be sent free upon receipt of a self-addressed, stamped envelope.

MODELS



Brig MALEK ADHEL, 20" bull frameand-plank or solid-hull construction. 31 25 304-305-306-R Clipper Ship in a Bottle, 121-122 1 00 hull, 51 52 53-R Cody Coach 13" long. 144-145-146-R. 1 00 CONSTITUTION ("Old Irons)des"), 21" hull, 57-Cruiser U S S. INDIANAPOLIS, 12" long, 216,25 New Bedford Whaleboat, with complete equipment, 14" long 326-R Privateer BWALLOW, a Baltimore Clipper, 13" Racing Yacht, 20" Marconi-rigged sailing model, 46-R ALABORIE COLLABORITORIO CONTROL C U. S. Battleship TEXAS, 3' hull, 197-198-199-200., 1 00



BOATS Cabin Cruiser 17' long, weighs 750 lh., for use with outboard or inboard drive, 356-357-358-359 R Folding Duck Boat, 13' long, 170 R ... Fisherman's Outboard Boat, 8' 3" or 11' 6" long, .60 weighs 115 or 160 lb., for motors from 3 to 16 h p., can also be rowed, 344-345-R. .75High-Speed Boat for Small Outboard Motors, 7' 11" long, 257 R. .50 Motorboat-Rowboat, 13' long, with decked bull, .50 for use with outboard or inboard drives, 147 R Plywood Dinghy, 9' 7" long, weight 60 to 75 lb., can be rowed, sailed or used with small outboard motor, 387-388-R.

(Continued on page 213)

New Index Lists Every Article of Interest to Home Craftsmen



APPROXIMATELY 900 pages of POPU-LAR SCIENCE Were devoted to home. workshop, and other service material during 1940, and the 1940 Home Workshop Index lists every item. Whether you wish to locate plans for a desk or read what Gus and Joe did to

put out an auto fire, you'll find the Index an instant aid in finding the article. Just send ten cents and a long, legal-size (No. 10) self-addressed envelope to Popular Science Home Workshop Index, 353 Fourth Avenue, New York.

Plans for the Workshop

(Continued from page 212)

Racing Sailboat BLACKCAT 13' 4" long, weight	
250 lb. Marcont rigged 321-322-323 R.	1 00
Beetional Rowboat, 9' 8" long, can be used with	
small outboard, 240 341 R	. 75
Sport Runsbout. O' 8" long, for small outboard	
motor, weight 100 lb 309 310-R	75
Utility Rowboat 13' long can also be sailed or	
driven by outboard motor, 224-R	- 50



FURNITURE

Colonial Writing Desk, 3' 6" high and 3' 8" long 21 Combination Bench and Tilt-Top Table (no turning), 11	.25
Troplace Bereen (brase and wrought fron). Bed-	
ande Cabinet, and Trinket Box. 389A	.25
iate Leg Table 3' 6" diameter, circular top with	
leaves up (no turning), 24	25
ewing Cabinet of 1813, 178A	50
avern Table and Scroll Mirror, 105	25
e ephone Table and Blook 18	25
"Ht-Top Table 20" by 24" top, 240A	.25



MISCELLANEOUS

Automatic Lighthouse Night Lamp

LANGE THE RESIDENCE THERETO GRANDE WITE STONE	100
Bird and Animal Patterns 58	25
Electric Train Horse, and Doll House, 14	.25
Perpetual Star Chart, 314	25
Projector for Photo Prints and Pictures, 259A	,25
Bandpaper Cabinet, Saw Horse, Tool Rack, Hand-	
Screw Rack, and Machinest's Hand Vice, 368A	.25

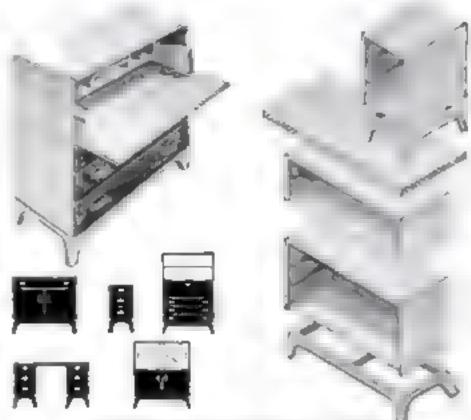
FOPULAR SCIENCE MONTHLY 353 FOURTH AVENUE, NEW YORK

Send me the blueprint, or blueprints, numbered

	01	1	4-11		
T MAIN	12160	oliring. *	 .eratiob.	-11	XIII C
No.					
1484D			 		
4					
RILES	le		 		

Build this new, modern UNIT FURNITURE

designed for Casco by Russel Wright



15 DIFFERENT FURNITURE PIECES FROM 6 BASIC DESIGNS!

TNIT Furniture brings "assembly line" speed to your workshop. Build any number of units you need. Assemble them to make the furniture you want for living room, dining room or bed room. Each piece of furniture brings you the finest in modern design, by a famous industrial designer!

Complete working plans and directions for building Unit Furniture and 21 other professionallyplanned projects are available free to Casco users. Free book offered below tells how you get them. Send for your copy wew. It's more fun to build better-designed, better-planned Casco Projects.

FREE ... BOOK OF NEW CASCO PROJECTS FOR 1941

16 pages. Illustrates 24 modern and traditional pieces by Gilbert Robde, Russel Wright and Herman Hjorth. Tells how to get free plans, includes other helpful home workshop information.



secol by Gases Pandered Creein Glac, the Mad glutag. 100 ta 650 at Hardware, Paint and Lumber Dealers

PROJECTS	350 Madison Av	N OF AMERICA, Dupt, PS-141, 1900, New York, M.Y. e a cepy of the new, free ROJECTS " by return mail.
- Sant 2s	Citystick compan	State





Submarine Chaser Is Added to Construction-Kit List

DECAUSE of the tremendous interest in models of war vessels at the present time, POPULAR SCIENCE has just added a aubmarine chaser to the list of construction kits available. The prototype of the model pictured above cruised from New London. Coun., to Bermuda, the Azores, Portugal, and France; and operated from Plymouth, England, to attack many U-boats during the first World War,

The model is 20%" long, and was scaled 3/16" to 1' from official U.S. Navy plans. The kit contains a precision-shaped hull, raw materials for deck and spars, and all the finished fittings, such as propellers, ventilators, guns, ladder, blocks, bell, stanchions, and the like. Kit 12S, \$7.00†.



MARIONETTE OF DOPEY. That comical little fellow. Dopey, in Walt Disney's animated fairy tale, "Snow White and the Seven Dwarfs," is prancing across movie screens once again. Thousands of theaters are reviving

the picture, and our marionette kit will provide a timely Christmas gift. All the parts are completely finished and can be put together in about half an hour. Kit 12, \$1.75† (reduced from \$2.25).

MINIATURE COLONIAL KITCHEN. The entire family can share in the fun of putting this model together. The tiny room, accurate in every detail, is 21" long, 7" high,

(Continued on page 216)



You'll be proud of the mtin-

Macoth, professional finish

you will produce with

Please mention Popular Science Monthly when writing to advertisers.

7 SKILSAW Lane gr.

ZEPHYRPLANE JR. -caster and faster-and you'll get

more pleasure out of your work when you eliminate the

tiresome job of hand-sanding. Easy to handle—weight only 91/2 lbs., perfectly balanced for uniform pressure on the entire sanding surface. Never any rippies, ridges or scratches.

lden for wood or metal. Link-belt drive. Touch control lever makes belt-changing easy. Works from any light socket.

SKILSAW, INC., 4777 Winnemac'Ave., Chicago

◆SEE IT AT YOUR HARDWARE OR MILL SUPPLY BEALER'S

minutes of effections





60 POWER TELESCOPE...\$219

NEW I Three telescopes in one. 3 different magnifications. extra long range. Guaranteed to bring ducant objects people, sports events, ships, moon, stare etc., 60 times ak

then a feet in length. Multiple lens system 10 the objective lens is section. Directions in length, Multiple lens system 10 the objective lens is section. Directions in lended for unity as a compound a lens informations made. Frompt shipment guaranteed, We pay the precase "inly it? It is section." The process of the pro





A real Money Maker for farm or factory Uses cheap fuels—pays for itself out of savings, Low factory prices—Easy Terms, Write for Engine and Logsaw Catalog



WITTE ENGINE WORKS 12221, 224



enhance prote of membership with puts or rings. Bastisms big relection, low prices, traditional clean-cut quality work has hed the field for 46 years.

WRITE TODAY FOR NEW FREE CATALOG! BASTIAN BROS. Dept. 83. Rochester.



AMAZING LOW PRICES

Thu want this Great Ra to Cal this -new Camera and 3 way portables Recorders Phono Comnodels. Auto Sets Amateur Receivers—al. At lowest prices 24
New Sound Systemal For every
P.A. apposition 7 to 75 walts.
New features low prices Time
Payments: 15 Day Trial Offer New
Buildors' Kital Dozens of new Rado Kita new diagrams everything
for the Hallder and Everythene for the Builder and Experimenter Learn Radio—let ALLIED help you Fluorescent Lighting. For Rome, Workshop office etc See our compete section 18,000 Items! Everything in rad or service test equipment-replacement parts emeteur est prices!





LEARN RADIO



that complete by leading on the complete by leading on the collection of the collect



. 2 TUBE MIT. Same as hit at right makes all property but 28 B

. SPECIAL OFFER! Radio Builders been one a Easter men era get these trans new genuthe Rt A kits m. less than he's he require price' Learn radiably pactical construction in a TUBE MIT. But d'a real a Tust Rece ser an electronic bargiar alarm H me Broadcaster M rac Code Practica Set etc. K includes 1 RCA tube, auchette condencers regulors resocketa condensera rematora recoulder up to a and solder wire trabetrir relay telegraph key wring dis-grams. 15 page tutruet on book RETURE

Hegas ar price 3.76	57 59 For Hunted
ALLIED	RADIO

633 W Jackson Blvd., Dept. 7-A-1 Chicago, Illinois

- " Rush me your PREE 1941 Fall Radio Catalog t enclose for for Radio Builders' Handbook
- " I enriose 10s for New Radio Dictionary
- I f enclose \$2.95 (plus postage) for I Tube

RCA Elt.	\$3.75	(pitts	\$contrage)	100	2	Tube

Name		+	+		 	
Address	,			1 444	 	
Cilg .				. State	h =	

THE PRIZE GIFT for



JUNIOR, GRANDPA

Does just about everything on metals, wood, alloys, plastics, horn, bone, glass, etc. Uses 300 different accessories to grind, drill, polish, cut, carve, rout, saw, sand, sharpen, engrave.

ORIGINAL AND FINEST HOBBY TOOL, Nothing like a Handee to keep boys happy. Gives men a real hobby making useful and beautiful gifts or things to sell—slop, train or plane models, costume jewelry wood carvings, puppets, initialed tumblers, engraved trays, etc.

Why-with a Handes a fellow can set up shop wherever there is an electric outlet. Be sure to give a Handes this Christmas, or get one for yourself

Order on 10-days money back trial

De Luxe Model 25 000 r.p.m. with 7 accessories \$18.50 postpaid. Standard Model 18,000 r.p.m. with 3 accessories \$10.75 postpaid.

HANDEE HOBBIES-Scale drawing plans of fuscinating new projects, 25c for portfolia of 10.

Send for free 64-page cutalog

about Handes Products and their wide application in crafts and industry all over the world.

CHICAGO WHEEL & MFG, CO. Chicago, Ili. - St.

Seve Hours of Hand Warts

BENJAMIN AIR RIFLES WITH HAND MADE IN

> ACCURATE SHOOTING WITH CHAMBERED

You can use new made) hendanth and differ with Leven Many Pump anywhere, for practice firing or just plink-ing, among the house or can ping dehian burt on et at los at cast theoring force to adjustable with amoning maximum newer and acturaty no receil of to want idage to disample, and, a m. Bolt Action Harmer Fire Mais Trigger halvy both mand Fump. Sugger Shot PB S. Sh Sengte Shot Call I are 22 w his very larger 50 are the 25 Not TB S. Sh Sengte Shot Call I are 22 w his very larger 50 are the 25 Not TB S. Sh Sengte Shot Call I are 22 w his very larger 50 are the 25 Not TB S. Sh Sengte Shot Call I are 22 w his very larger 100 are completed after of Benjamin Certains Compression and Plants of the Shot TB S. Shot TB On A sength of the complete of the should be completed at the complete of ST LOUIS, MO , U \$ BENJAMIN AIR RIFLE CO , EP3 MARION ST





Light Socket

Light Socket

Amating new HAND!

Will D Electric Ard

Welder-appeales from 110 volt.

A I in P I have as other are

welders higher priced generates bremen
dote heat to weld at k ode of metal Sock
a tay we der that the carbons but nets
also I hear standard costed rods stare a lat
and I I hearman sond y form shed with
we der Guarabired got to born out Re
por in fenders moto bod ets rad ators yet
her ed amais east ogs and finishingery parts.

Take HANDIWFID maywhere to lob opgrate from light socket Standily built of
does materials to last years. Paily guar
enteed by Hig Manufacturer.

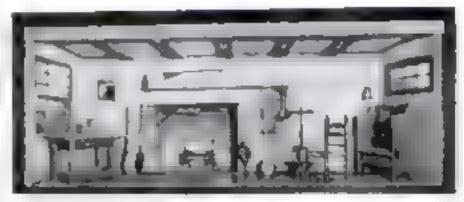
BEND NO MOMEY Too is find a thousond ness for the HANDIWELD assund
vour home, garage, work shop Also by
gatages, factories, repair shops, furnetts,
inventors, the shops, plumbers, etc. Order HANDIWELD how Send so money.
We'll rush one to you, complete with
rude and song es. Pay postman only \$2.95

I days from receipt and money paid for it will be refused instant'y. Rush your order now

RUMSY PRODUCTS CO. Dept. M-205 Gincinnots, O.

Kits Make Fine Gifts

(Continued from page 214)



and 5" deep. See P.S.M., Nov. '40, p. 206, for a complete description. Kit 13, \$2.00.

EARLY COLONIAL TAPROOM. great was the interest of our readers in the Colonial Kitchen that POPULAR SCIENCE now offers an Early American taproom. signed to a scale of 1" equals 1', the new model depicts a typical tavern scene, the activities that today are divided among hotel lobby, lounge, writing room, bar, and dining room went on in this single lowatudded room. Here the gossip of the countryside was told and retold: the old room furnished the setting for political, civic, and military conferences.

The kit contains walls, ceiling, floor, fireplace, and clock printed in four colors on



heavy cardboard; thin wood from which can be jig-sawed the flat pieces for the table, bench, and chairs; turned chair rungs and uprights; finished metal andirons, tongs, sconces, jug, lamps, and tankards; dowels, wax, glue, and pins. Kit 14, \$2.00.

SOLID MAHOGANY BOOK TROUGH. Any member of your family or a friend would appreciate receiving a beautiful book trough. It is 22 1/2" long, 9 1/2" wide, and 24%" high. The kit contains all the necessary wood ready to assemble, and finishes. Kit 4, \$5.30*.

"HOBO HANK" WHITTLING KIT, Anyone who enjoys carving things with a pocketknife will like this kit. It contains a (Continued on page 218)



PATENTED

. S. BRACH MFG. CORP. 53 Dickerson St., Mewark, N. J.

Illg valuable inherstory catalog early worth He - FRAK-dating thomasule of C. If therefore, apparatus, infrincepes, scientific books, bloingers; and isheretory supplies from as low so be Equipment for complete industrial processing and home laboratories as bargain prices. Neve money, Just write people of for a short time only there will be an meding charge. Get just copy of handbook NIJW!

KEMKIT SCIENTIFIC CORP.

297A Bridge \$1.

Breeklyn, New York



J. H WINN S big catalog of Chemicals and Laboratory Supplies for High-

school and College Students, new ides Chemical with & Apparatusouthis, Scientific Books at a dis-count, Telescopes, Microscopes, Biological needs, Photographic Biological needs, Photographic Chemicals, Scales, Send for catalog

J. H. WINN MFG. CO. Best. 101-124 W. 23 St., M.Y.C.



representatives says to the the terms but to Mittel

WHITE FOR MEW BOOM was ust in that a manual to the return of the part of decrees provided and the first of the refunded on the group Mig.Tt. Tt. part;

S. Beth Physical and Lumber Str. 2207 M. Helated Str. 9

CANNOT INJURE ALUMINUM CTLINGER HEADS AND FITTINGS

EARS OUT AUTOMOBILE RADIATORS

ACTION! THRILLS! ADVENTURE!

Explore distant pieces are new a glass visit piessure at other cost. Pai with fundamental riders at exclusing motorcycle events. See new 1941 models at your Har ey Davidson designs. Write for FREE copy of the housest En husiant motorers og motores H Davidson Mater Co., Bept PS. Miswaukee

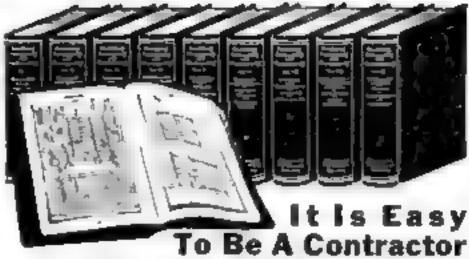
MARLEY-DAVIDSON

Anyone can assemble. Complete instructions form shed. All metal parts beautifully anished. Newest starter type electrical equipment fully guaranteed by an hiew thatow can, glareless i.gh every. Planteteent i.ght on office the greatest Newest starter type electrical equipment fully guaranteed by an hier stated was, glareteen to the every cone is the management in the committee of the greatest improvement in the committee of the creatize of the creatize and the greatest improvement in the committee of the creatize cost four fourescent are now retailing for facility of the regular cost four fourescent length of four incandescent believed to the tight of four incandescent believed to the creatize of the regular cost four four the tight of four incandescent believed to the first of the creatize cost four four the tight of four programment in the committee of the creatize cost four four four incandescent believed to the first of the creatize cost four four four profitable becames material to cut your light held in two.

Best first in your four.

NATIONAL FLUORESCENT SALES and SERVICE COMPANY Chicago, thingsing

FOR HOME WORKSHOP STORES.



Learn to estimate, to plan buildings, to take contracting Jobs, and make money on them. Here are 9 up to the minute books on building, estimating, and contracting which cover in an interesting way, the subjects that carpetters, builders, and contractors should know to make the most out of their John. Roof Framing The Steel Square Architectural Drawing and Design. Estimating Painting and Decorating Heating, Air Conditioning Building Contracting, Concrete Forms, and other subjects are all well covered.

Boss Carpenters in Demand 1.940 KOITION

Vant public works jobs Immense projects and the capid growth of home building are making jobs for MEN Will KNOW JOW. Three books give you quick training with them you won't be attend to tack want job for needed facts can be found in a

These books just off the press in 1940 are the most up to-date, complete we have ever published.

Coupon Brings Mine Books FREE For Examination

AMERICAN TECHNICAL SOCIETY Dept. 6120, Dresel of 58th Street, Chicago, Hillingis

You may ship me the new 1949 ed time of your sine but books, "Building Re-timet as and Content as without any oil gation to hay I will pay the delivery charges only and if fully satisfied in ten days, I will send you go so, and after that only \$3 (to a month unit the total price of any \$29 30 in paid. I am not shippied to any way assess I here the books.

4 5141 491 57444191747444455411444

Please attack a fetter stat up your age employer a name and address, and that of at least our business man as a reference



CAUSE IT HAS A Floxible SHAFT AND Panell-Size HANDPIECE

New platt. new case for 64- every 200 arcraper in Rondredge prefedered craftsmen and new-promets to the homeerst hubby. Facedown than top instant and solution generation which is back to precision work in back to precision work in back to precise ground the generation modifies great and for delicate grain ground than general parts and for delicate grain ground that grounding discount and grain and accomplete for the statistic version and the Workshop, as I instruced.

TOURS ON 10-DAY FREE TWIAL

Order this Madel 45 FOREDOM straible
Shaft Workshop today Enclose \$14.95 rbeck
or M O -or we in C O D Try 16 for
10 days If mot make a mattacked return act
we refered FOREDOM fine
tools Weste for complete catalog,
FOREDOM ELECTRIC CO Dept. 186
27 Pack Place. New York N. Y.

PHET 1495 Including ld-pinte Accessory for

Modern wall so colling fixture.

Complete kit

Bul pottage Bul 95 cents extra

Polished metal cod caps. White enamed body Price includes switch



Please mention Popular Science Monthly when writing to advertisers.



de sole al di e y las e sor a e eleaning, sawing, etc. Not only high-

used by industry. Durn Orinders are outstanding for their streamhned mape—their extra power furnished by 6 E. Motors-their extra speed and smoothness. You can do better work every time with a Duro Grinder. There is available a complete grinder kit with accessories. Also equipment to convert the Heavy Duty Grinder into a Lathe Drill Press Shiper Carver Router and Bench Stand. If your dealer can't supply you, send order to factory. Also ask for Grinder literature.

DURO METAL PRODUCTS CO.

Your present power bill will buy a WITTE that produces power and light for ic a K W H. Sure up to 75% a size for every need, 2500 to 20000 watts; 1, 2 and 4 cylinders. Write today for Sounce plan, literature and name of dealer

WITTE ENGINE

WORKS

2221 OAKLAND AVE. MANSAS CITY, MO.

110Volt ACILLECTRICAL

We up third detector are we'der. I make the leafer to the further and the further to the further

Send the stamps for baryon catalog and book. How to hald Home Experimental Beach. ELECTRICAL SALVAGE CO., Box \$24-J-1



HERE I AM! To Fix That Broken Chair

Just apply Regers Glue to broken sectionprece, joint of splinter in position clamp chapped, spiantered and braken articles will become, look and remain the new when repaired with Rogers Chie recredible strong leasy to apply Setts 10c and up in tube. Jur or can at hardware stares swip, or send 10c for full saw per plus free illustrated book giving new ideas, new plans for making useful articles. How ,940 mets of free projects absens are also evadable-write Dept. A-Z. ROGERS GLUE, GLOUCESTER, MASS.

OLE DOC. "GLUEKY

TON OF STRENGTH IN EVERY DROP

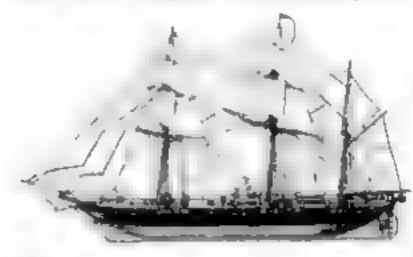
Kits Make Fine Gifts

(Continued from page 216)



master model of "Hobo Hank" so that all one has to do is to copy the model cut by cut on the stenciled pine block. The figure is 5 % " tall. Kit 10, \$1.50.

MODEL OF THE "ALABAMA." A decorative miniature of the famous Confederate raider will enhance your mantelpiece or



serve as a present anyone would enjoy receiving. The model has a 21 1/2" hull and is 28" over all. Kit 10S, \$8.20°.

Note: If you live west of the Mississippl River, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†)

The above are just a few of the many construction kits available. Send a stamped, self-addressed envelope for a complete list illustrating all our ship models.

Popular Science Monthly, Dept. 71A 353 Fourth Avenue, New York, N. Y.	
Please send me Kitfo	or which I
inclose \$(or send C 0.D. [7])	
Name	**** =*** -4*
Address	. 41
City State	
(Please print your name and address ver	
You save the C.O.D. charge by sen remittance with this order. Remit 1 order, check, or registered mail. Thi made only in the United States. Also above.	offer in

FISH CLUE



PRECISION HOME LOWEST PRICES!

Better built for heavy duty work just the this new attents and W up him take the first are bed. For test rest ziened in a learning of the Pule of V limb and discuss of other fine fra tures at at situal my ow process A. Write to day for high Rute that Hook of the best was a limb and best was a limb to be process. A. rempirte line of heermandes, too.

the hind just we naways wented in own. busing pro-STAR PRODUCTS, SQL Laws Ave., Pairfield, Jowa-

ARGADE



Drill Press, \$5.00 Disc Sander \$1.00 Jig Saw, \$5.35 and \$22.55 Re i Sander. \$4.00 M aper \$15.50 and \$20.50 Latin \$1.00 M. Man \$12 00 . Rench Saw 311 00 and \$22 .0 In far west abight y higher. Other Too s and Model Makers, Bearer or direct Fifth CAT-ALOH ARCADE MFG CO. 1218 Shawner St., Freeport, Ininola,

- - QUALITY AT LOW COST



Carved Hull Kits—Separate Fittings lodel Yacht Fittings---Sails & Spinnakers

Bend 20c coin for illustrated catalog

1002-9 Etowak Ave., S. Royal Dak, Mich. J. FISHER

BUILD A MIDGET CAR OR SCOOTER WE SPECIALIZE IN WHERE SETS SMOLNES,

Eff. for building fair. Stanfore Trucks, etc. We carry only the best at the lowest prices. Bend 10c fur parts catalog and place for three Midges Hancety Schoolses & ather schoolses. It pure to use only religible plans and parts. We guarantee satisfaction Bild-Ure Own Devices, SEE North Paraside, Ough. Ph. L. Chicago. cooter Outfit III an

For catalog, samples, 48 page Trafford Portfolio, send 25c (returned on 1st \$1.00 order), Experimental Kit \$3.00 pstpd. Trafford, Dept. 790, 360 Worthington St., \$3.00 pstpd. Trait Springfield, Mass.

Choose from World's Largest Line of Power Tools!

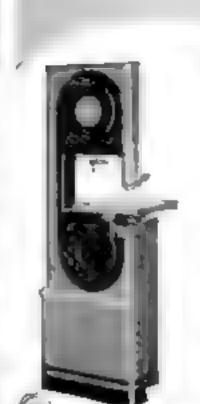
FREE New Latest Catalog covers Metal and Woodworking Tools accessories motors for avery purse. Write Walker Timer Co. Inc. 211 South Ave., Piainfield, N. J.

DRIVER Entimeered



Complete home-study courses and educational books a ightly used. Note tented, exchanged All subjects Money back guarantee Cash paid for used courses Full details and Plantraved 72 page bargain courses FREF We'lls today? NELSON COMPANY SOO Seerman, Deet A 203, Chicago

This is a miniature gasoline engine that really operates,



BAND SAW NOW-Faster — Smoother Safer Band Sawing

Once again - this time in a range langl pew 14. Band Sow-Barch-Crass is first with new lawteres and inganishes and peering.

Unlike ANY Band Saw You've Jeen

To build this one hind of pand sew with all its features at our low price. required new Buildriels, new production on methods, and a them break with tradi-Honal design. Just think! - 1 cold 100 finiter and amounther come to go at function "paces". From the built like plats. scraper and trel as it one. Other new feolures go o a

Lears all about the sequational Band Saw and other 1941 Boice trans Tools. include 10r for book that to is how to make motal on your shop lathe

CILT

Assemble This KI-YAK HOME



only 20 (be.

Oπ

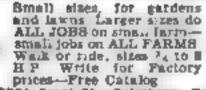
Carry It On Blks or By Hend

BOYR are how easily this 3 print out young ager carries his MAD hi YAK! What fun you'll have with one-AND you can assemble 1 YOU'll have with one-AND you can assemble 1 YOU'll stuff out to fit construction have being could could one it it for higher from our numbers of the factor of the fit of the factor of th



GAHDEN and SMALL FARM TRACTOR

A(r-cooled engines; auto-type gear shift; many fine features,



æ

SHAW MPG. CD., \$701 Front St., Galesburg, Rans.; BE12-P9 Mag-Chicago, 1If ; 130-PS West 42nd St., New York City; &cd., h St. Columbus Onlo Ha Ave . Chic

Mass production methods and enthusiastic



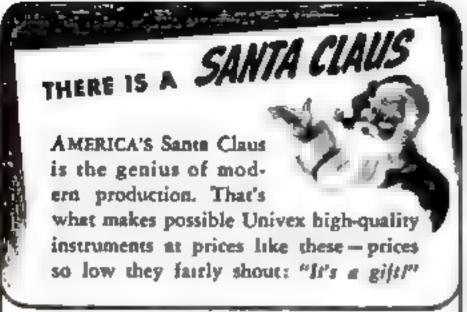
G.H.Q. GASOLINE ENGINE KIT ONLY

SEND ONLY **\$100** Shipped Cult

\$4.95 Over 15.000 sold this year—over 35,900 in the today. The NEW last returned last models at the Early sometimes and send and ready to assemble only a screw-driver and 30 minutes needed. For use in boats, planes, midget cars, etc. Send for FREE literature of \$c for jumbo catalog. ORDER TODAY-24 HOUR SERVICEIL

GRQ MOTORS, Dept. S. 40 East 21 St., New York, N.

reception have enabled us to reduce the price from \$15.00 uniqually to the NEW LOW PRICE OF 14.95 Over 15.000 sold this year—over 35.000 in use today. The NEW IMPROVED 1941 MODEL



"GUARANTEED" MOVIE CAMERA

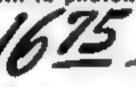


Movies that Cost

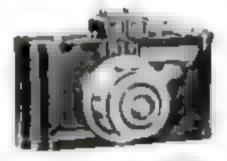
World's lowest-priced Bmm. movie camera with built-in optical view finder! (5.6 Jens. Uses 69¢ Univex Ciné film. Written guarantee. Model P-8 projector, \$16.50.

NEW, FAST "CORSAIR"

ONLY







Imagine a doubleframe 35mm, candid with f4.5 lens, stopping to 1/200th second — at 30 low a price! Mistakeproof features — it "thinks for itself!"

FAMOUS "UNIFLASH"



495



complete with detechable flach unit



Positive synchronization, Automatic Bulb Ejector, 60mm. Vitar lens. An allpurpose tamera for night or day, indoors or out!

UNIVEX MERCURY—Only candid with guaranteed accurate shutter speeds of 1/20th to 1/1000th second—features usually found only in cameras at \$100 and up—for \$29.75? Special Christman Offer—FREE with every Mercury—a daylight film winder and 2 daylight loading cartridges, permitting use of any type 35mm, bulk film.

UNIVERSAL CAMERA CORPORATION
New York — Chicago — Hollywood

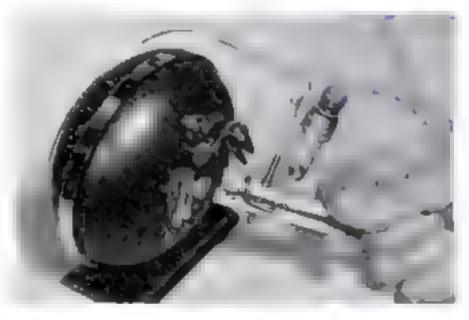
UniveX AMERICA'S BREATES



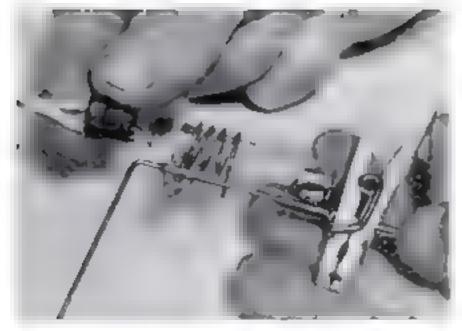
Mercury Switch Controls Alarm on Darkroom Timer

This darkroom timer consists of an inexpensive alarm clock and an improvised mercury switch. Cut off '4" from the jaws of a spring-type clothespin and round the inside of the jaws to fit the knurled knob by which the hands of the clock are turned. Take a bicycle spoke and turn on one nipple to leave enough of the threaded end to slip through a hole drilled in one side of the clothespin; then screw on a second nipple. A hole should be drilled in the other side of the clothespin large enough to slip freely over this nipple. The opposite end of the spoke is bent to form the indicator arm. An arrow is soldered on as illustrated.

Now coil a piece of spoke to hold a small vial as shown. The top coil is pinched smaller to hold the neck of the vial, and the end of the wire is bent to form an axle for the vial to swing on. Run this end of the wire through a small shackle bent from brass and soldered to the indicator arm. A drop of solder on (Continued on page 281)



The mercury-switch assembly clips on the knurled knob of the clock and turns with the clock honds



How the switch is assembled. The contact wires pass through the cork, which is inserted in the viol

the end of the coil wire keeps it in place. The bottom of the coil wire is bent at the same angle as the top wire, forming a stop which tips the vial as the assembly is moved around.

Some mercury is placed in the vial, which is fitted with a rubber cork. Wires that form the contact points are inserted through the stopper and bent as indicated. The stopper is inserted so that the points are on the underside of the vial as it tilts. Very flexible wires are soldered to the projecting ends of the contact wires and connected to the house doorbell circuit or a separate circuit. The bell will ring when the arrow reaches the position shown in the photograph at the beginning of this article, so all that is necessary is to clip the assembly to the knurled knob with the indicator arm set back the number of minutes desired.

Heavy Corner Angle Converted into Serviceable Tilting Top

An ordinary heavy corner angle forms a serviceable tilting top for a camera tripod. The tripod acrew passes through one of the



holes in the angle. and a nut fastens the angle. Cut the head from a machine acrew of a size to fit the tripod socket of your camera, and insert it. By passing this screw through one of the boles in the other leg of the angle and adding a wing nut, you can lock the camera securely at any angle. -George Horst.

Please mention Popular Science when writing to advertisers.

DO YOUR OWN DEVELOPING

darkroom kit



Get that "something actro" into your prints that makes a salan standard out of just another picture. Begin now to do your own developing. This 18-piece complete developing and printing outfit provides of the necessary essentials. Valued et \$3.95, here's real maney-saving you wen't \$2.49 went to miss at this low price

BE SURE YOU SEND for catalog of latest nationally advertised comeron and equipment. It's FREE! 50 pages of values to save you important money. A postcard will do, Mail at once.



HEW YORK, M. Y 100 Sinh Ave, CHICASO, ILL, WIW Jochian Blod, ATLANTA, SA, 201 Processo Stone BOSTON, MARS, BROWN, M. T. HEWARE M. F. JAMAICA, L. L.

Dopt, 9AC1-100 Sixth Ave., New York, N.Y.

Rush Fitte Camera Catalog No. 81.

I enclose \$_____ Rush my order.

NAME .

ADDRESS _

CITY .

STATE





Te you but to him to hi

PHOTO ENLARGING

Tells you how to transform your ordinary negatives into big, beautiful pictorial enlargements. Written by experts in the amateur's language. 36 pages, profusely illustrated. Loaded with meaty information on enlarging, diffusing, dodging, double printing, photomontages, toning, spotting and mounting, or cost of mailing, etc. Big photo

Send for coin to cover cost of mailing, etc. Big photo catalog free, Write Dept. PS141. Act now.

223 W. MADISON ST. . CHICAGO, ILLINOIS



of Jupiter

POWE Amazingiy

Study the wonders of the heavens—the mountains of the Moon, the planets com-els, stars Strange thrills! Hours of fun

cls, stars Strange thrills! Hours of funwith this big powerful reflecting tels
scope EARN MONEY FOR YOURSELP
Charge loe for a look at the moon NOT a KIT A spandid sustrument stardis built in three inch, heavy metal
tube with machine ground, hand finished reflecting lens
48 inches long finished in black crystalized ename! Will
leat lifetime, Guaranteed that you see the Moons of Jupiter Can
be used to take telescopic pictures and as a spotting scope for lar
fet practice Complete and ready for use. Nothing case to buy
TEN DAYS FREE TRIAL Rish only \$100 now Pay belance
(12 95) plus postage when postman delivers Krep ten days. If not
more than delighted, return telescope and money will be swiunded,
KUMSTY PRODUCTS. INC., Dags., M.501

KUMFY PRODUCTS, INC., Dept. M-501 Cincinnati, Ohio 6033 Eastern Ave.

WATCH this publication for announcement by UNIVERSAL CAMERA CORPORATION of its spectacular program for 1941!



WHEN YOU BUY FLASHLIGHT BATTERIES DEMAND "EVEREADY" FRESH DATED BATTERIES

The word "Eveready" is the registered trade-mark of Rational Carbon Co., Inc.

WOOD CARVING and WH AN ARTISTIC HOBBY FOR ALL

This brand new manual shows you how to do every kind of wood carving. How to carve jewel boxes, picture frames, trays, chests, furniture, etc. How to do chip carving, level surface carving. incising, carving in relief. Carving human and animal figures in the round completely explained and simplified. 256 Pages. Fully illustrated,—full cloth bound Send only \$2.00 and your copy will be sent postpaid, or order COD plus postage if you wish. Money back if not satisfied.

Popular Science Monthly-Dept. 11 353-4th Ave. New York, N. Y.

Printed Matter Split in Two to Preserve Both Sides

PHOTOGRAPHERS sometimes wish to make a contact print of a picture or printed matter, but cannot do so because there is printing on the other side of the sheet. One solution is to split the paper in two. This is not at all difficult. Paste a piece of cloth or very strong paper to each side of the sheet to be split. When dry, pull the two pieces asunder violently and without hesitation. Part of the sheet will be found to have adhered to one, and part to the other. Soften the paste in water, and the pieces can be easily removed from the cloth.

The process can be used in various ways. If it is desired to paste in a scrapbook a newspaper article printed on both sides and there is only one copy, it is convenient to know how to split the paper. The printing will be legible, but somewhat dutler than it was originally.—J. C. BRANSTETTER,

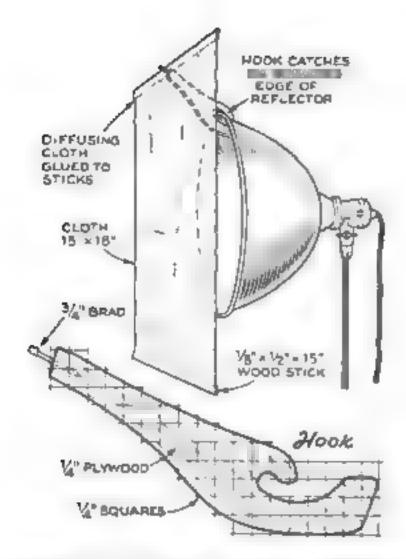
Determining Exhaustion Point of an Acid Fixing Bath

EVERY photographer realizes the value of using fresh hypo to fix his prints, but he often throws away the solution when it is still good. A quart of acid fixing bath is suitable for 2,000 mg. in, of print surface if care is taken to dip the prints in a stop bath before transferring them to the fixing bath. This means that 273 prints of the 2¼" by 3¼" size may be safely fixed before throwing out the solution. Approximate figures for other sizes follow: $2\frac{1}{2}$ " by $4\frac{1}{4}$ ", 188; 3¼" by 4¼", 144; 3¼" by 5¼", 111; 4" by 5", 100; 5" by 7", 57; 8" by 10", 25.

Keep the bath on the acid side by adding a few drops of pure acetic acid occasionally. You can use blue litmus paper to test for acidity—it should turn red. Keep the temperature of the solution at about 70 deg. F., because sulphur is precipitated at higher temperatures. This causes yellow stains to appear later.—J. H. W.

Lacquer Protects Movie Film

APPLIED to one or both sides of 35- or 16-mm. movie film, a new lacquer effectively protects them from scratches. The coating, rather than the film itself, receives the surface wear. When this has gone far enough to affect projection, the lacquer, according to the manufacturer, can be removed and a new coating applied, making the film as good as new



Plywood Hook Holds Diffuser in Front of Photoflood Lamp

A DIFFUSING cloth can be hung in front of a photoflood lamp by means of a single hooklike bracket jig-sawed as shown from ¼" plywood. It hooks on the reflector rim and holds the cloth far enough out so that it will not be accorched.—JOSEPH WILLIAMS.

Flattening Work for Copying

To Hold an original picture or document flat when copying with the camera, cut a piece of corrugated board a little larger than the copy and use a spring paper clip on each corner as shown .- J. H. DUNNEWIN.







Power cross feed V-belt drive precision-ground bed ways backgeared power, 16 speeds—as low as 599.75, 6 lathes, \$61.50 and \$64 50.

DRELL PRESSES

Smooth. accurate floating drive" deeign with ball bearings. models \$17 25 0 \$44.75.



news of the year for modelmakers, inventora, experimental and all types of metal working shops.

Handles the full range of milling work-slabbing, end milling and keyway cutting, finishing. layout. Operates from 1/8 HP 1740 RPM motor. \$175 and up less motor and arbor. Send for 1941 Catalog with complete details. ATLAS PRESS CO. 155 N Pitcher St. Kalamazoo, Mich.

ATLAS PI	TERS !	CO.,	165 N	. Pitch	or Sta	Казоналоо,	Mich.
Please	send	me	your	1941	Catalo	g on.	

...

- New Milling Machine
 - Drill Presses
- Arbot Presses
- 10" Metal Lathes 6" Metal Lathes ?" Metal Shaper

Name -

Address

City and State



Learn to set up and run ANY kind of machine: MAKE MORE MONEY NOW by learning quickly HOW TO DO THINGS which unually take years of atudy and practice! The demand for SKILLED men is AL-READY shead of the supply,

Needed

then what WILL IT BE a month or two from no

Bigger Pay ton. don't miss this chance to qualify for promo-tion, don't miss this H.g. Opportunity which is yours almost for the asking Eight Big Books chockful of important mechanical facts told simply and clearly. Over 3000 pages nearly 3000 Hastrations cover every subject July Includ-ing Tool Making, Pattern Making, Foundry Work, Mechanical Drawing Forging Machine Shop Practice and Management, and bundreds of other subjects. and hundreds of other subjects,

8 Big Books (1940 Edition) Sent FREE

to you for examination. With them we send a Big Blader of nearly \$00 pages with 267 original shop tickets with 1200 illustrations. These show step by step how to set up and run atmost any kind of job and are in addition to the 8 books. Decide in your own home or place of business whather or not you want to keep them, check up on any facts you want to. Note their great MONEY MAKING value, then, if you want them pay on the examps kind of payments. Send NOW and we will, for ude a year's consulting service without extra charge. American Technical Society, Publishers—Home Study Courses.

American Technical Society. Cept, \$130, Dread at 58th St., Chicago, You may send for the dilig Nt W books and binder of ship tickets for free stam nation. I will pay the delivery charges only univer I decide in keep them in which case I will send \$3 to lique days and \$7 00 per month until the total price of only \$14 % is paid. If return them is if I days I will now you nothing Because I send now you agree to give me a certificate entition me to consulting provileges with your experts for one year.

Marne . .

Address and that of at least one business man as reference.



BENJAMIN AIR PISTOL WITH HAND PUMP





describing over 100 d. Street kinds of wood in 340 d Sevent lives in reserve, lumber panels, lusay work, turning against, and hespful weathering add. Printed and i lusativated articles on New to Make Inla d Pletures; How to Make Vencered Pane a, New to Fin at It Sevent Kinds of Woods, A source of sopply for you in amal) stand quantities, every kind of wood you are looking for Send inc today to stange or coin."

ALBERT CONSTANTINE & SON, INC., 783-86 East 125th St., N. V. C.

Gus Tackles a Tough One

(Continued from page 142)

You never know what you'll find, Let's go!" They disconnected the clutch pedal, and methodically went about removing the clutch. All of its working parts seemed to be in perfect condition. The thrust ring fitted anugly. There were no projecting rivets. The clutch shaft was in alignment, and so were the bearing seat on the clutch sleeve

Gus said something under his breath. Harry laughed. "It sure does me good to see you stumped," he said mockingly.

"Go right ahead and enjoy it!" Gus told him. "There's something screwy about this job. Well, there's no sense in wasting more time on the clutch. It's all right."

They put back the clutch and replaced its cover. Then they started to reinstall the transmission—but for some reason it didn't

slip smoothly into place.

and the throw-out yoke.

"Now what?" Gus grumbled, "Hey, look at this!" He pointed at one of the hangers, which also acted as a rear engine support. It was badly bent. "There's the cause of that darned noise!"

Harry examined the support. Then he did some thinking. "I don't get you," he confessed at last. "The hanger's bent, of course, but what--"

"The front end of this car has been wrecked," Gus said, "and that darned Magruder didn't have sense enough to tell me about it. Look—this cross member is bent, too, on the same side. Whoever botched up the repair job forced the bent hanger into place on the bent cross member, That cocked the engine a little, and cocking the engine took most of the road play out of the drive shaft. Putting the brakes on hard caused the engine to move a little on its rubber mountings. That further decreased the amount of play and caused that grinding hoise. I knew there was something screwy about this job!"

"Well, what'll we do now?" Harry asked. "Go home and go to bed," Gus said. "First thing in the morning we'll straighten that cross member and put in a new hanger to replace that bent one—and that'll be the job! Maybe I won't tell that championcollecting Magruder something when he calls up! He'll find our time on his bill, but I might have gone to a movie tonight."

"You might have," Harry agreed. "But you know darned well that you enjoyed this a lot more than you would have a movie."

Gus grinned, "Sure I did," he said. "I like a sweat-and-cuss job once in a whilethey get you up on your toes!"

Please mention Popular Science when writing to advertisers.

Plastics in the War

(Continued from page 84)

the Channel on night raids, the gunners who man the machine-gun turrets at the tail sit enclosed by transparent plastic windows and surrounded by plastic aids. Even the vital ammunition conveyors, carrying cartridge belts to the machine guns, are now produced from synthetic resins. According to advices from abroad, aircraft manufacturers in England recently conducted a survey, listing every possibility for replacing metal with materials created in the laboratory. In each new design, plastics play a greater part,

At the De Havilland plant, near Hatford, England, a steam press capable of exerting a giant's grip of more than 4,000,000 pounds pressure is turning out laminated apruceand-Bakelite blocks for the manufacture of propellers. Another wood-and-plastic product, known as Jabroc, supplies the material for producing dies used in the fabrication of sheet steel and aluminum alloys. Such dies will endure more than 2,000 pressings without losing their shape. In the aircraft industry, where changes in design are frequent, the ease with which such plastic dies can be made is of great importance. Bearings and gears, produced from textile-mill waste material impregnated with synthetic resins, are reported in wide use in wartime German factories. A feature of such plastic gears is the fact that they are self-lubricating.

A few weeks ago, in a New York City laboratory, an American inventor demonstrated a new type of leakproof fuel tank for fighting planes. Firing pointblank, he sent .45 caliber bullets crashing through the gasoline container. Each hole was sealed promptly by the swelling action of a latexand-plastic layer which lines the walls.

Of all the widespread wartime applications of synthetic resins, the one with the most dramatic possibilities is the present concentrated effort to produce plastic planes. The vision of streamlined fighting ships pouring from the production line has caught the popular imagination. In many parts of the world, engineers are tackling the problem in deadly earnest. Recently the Glenn L. Martin Company, one of America's largest producers of bombers, established a fellowship for plastic-plane research at the Mellon Institute, in Pittsburgh, Pa. Howard Hughes, famous round-theworld record holder, is reported to be building an experimental bomber of plastics in his Los Angeles factory. The Timm trainer, (Continued on page 226)

STOP

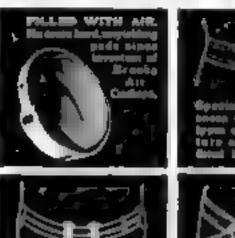
Your Worries About

Rupture

Why put up with days . . . months . . . YEARS of discomfort, worry and fear? Learn about this perfected invention for all forms of reducible rupture. Sucely you easerly CRAVE to enjoy life's normal activities and pleasures once again . . with the baunting fear of rupture bankshed from your thoughts . . with no more suffering from an Ill-fitting, gouging burning hard-had trues Over 3 000 000 persons before you have used the BROOKS Appliance. Enjoy the comfort and safety of the Patented Air-Cushlon Support, yourself! Over \$,000 physicians use the Brooks themselves or recommend it to patients.

Cheap-Sanitary-Comfortable

Anyone can afford a BROOKS patented Air-Cushion and enjoy the Paradise of comfort and accurity it affords. The Brooks has no springs, no metal girdle. The yielding Air-cushion of the BROOKS, the velvety









hody band these will be utterly new to you . . . and how you will bless the day you discovered this complete security. The BROOKS Appliance adjusts itself to every body movement. The Patented Air-Cushlon does not gouge in and spread the rupture. Thus Nature has a chance to close the opening and make a truss unnecessary. We do not promise this result . but thousands of BROOKS wearers have joyously reported its occurrence

SENT ON TRIAL! You are not asked to risk any money. You can try a BROOKS at our risk. If you don't think it is wonderful, simply return it. and the trial costs nothing. But avoid imitations. The BROOKS is never sold through stores. It is made to your individual measure. Write for full information, free. And remember a Brooks will be sent on trial.

BROOKS APPLIANCE CO.

459-D State St.

Marshall, Mich.

MAIL THIS COUPON TODAY!

Brooks Appliance Co. 459-D State St., Marshall, Mich.

In FLAIN ENVELOPS, please send your FREE BOOK on Repture, PROOF of Results, and TRIAL OFFER. No one is to call on me personally about my Rupture

Chara mbathar for Mar		William		Andre 6	CONTRACT AND ADDRESS OF THE PARTY AND ADDRESS
City	entri		8	tate	
Bireeka aan a aan a					
Name					



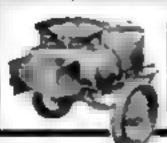
GOOD TOOLS NEED GOOD

When you work with tools, they must be in working condition, 3-IN-ONE Oil keeps tools clean and bright. It oils the working parts; protects against harmful rust and tarnish. Get it at Hardware, Drug, Grocery, 10 € Stores.



3-IN-ONE OI



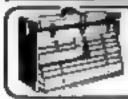


We will furnish complete instructions with a Smith Compressor Head and Accessories

With a Ford Music 482 also faculties you can easily assemble a Smith Air Compressor You'll have a smooth performing efficient compressor with 50 cu ft a minute capacity at the power you need to operate rock dri is and paving breakers Pressure up to [75] his a suppressor lock dri is and paving breakers Pressure up to [75] his a suppressor lock dri is and paving breakers pressure up to [75] his a suppressor interest part of the suppressor valvest automatic unionality and idding.



GORDON SMITH & CO. Inc. 405 College Street Bowling Green, Ky.



GERSTNER Tool Chests Retter working everywhere use and recom-mend Gerstner Chests Free Catalog to took makers and much usta, QUASTMEN TOOL CHESTS 642 Columbia M. Dayton, date



UNHEARD OF VALUE at

Complete with 30 piece Arbor Tool Set and Heavy Bench Stand The double duly ejectric power

tool that combines the conven-lence of a bench grinder with the procision of a hand grinder. Use 2 either way as a stardy leach grinder, or recover the heary cast from have and copyrich it into a fibrate place hand trail

with a great saving to them and effort

At this low price, order your grinder NOW. Rush \$1.59
Includes 30 piece Arbor Tool Set in Selector Box Cutters, but for some control to the said effort.

At this low price, order your grinder NOW. Rush \$1.59
Includes 30 piece, order your grinder NOW. Rush \$1.59
Includes 30 piece, order your grinder NOW. Rush \$1.59-

Quaeral Aire Co., Dept. P. S., 118 H. Sth St., Philos, Po.



SO PIECE UNIVERSAL 95¢

Indispensable to Jewsley, Laboratory, Model Maker and Rome Craftunan. The ideal could for fine accurate grinding, eaching, counting or curving. In cludes 12 grind stones with brass contest in assorbed stone for batchte cut off wheels, 6 seasoned congressing routing or curving burns, 2 polishing boths, 2 bristle polishing brushes circular and cup shape 3 sounded arbors. 22 seasoned sending discs of recesy garget, send, fine, medium and course.

Bend Cain or Mency Order Shipment Propole

Beneral Aire Co., (Dopt. P.S.), 116 M. Sinth St., Phile., Po.

Plastics in the War

(Continued from page 225)

another California product, has already flown. Eugene Vidal's Summit monoplane is nearing tests at the Bendix Airport, in New Jersey.

Vidal and Col. V. E. Clark, two American pioneers in the plastic-plane field, are both men of wide aeronautical experience. Vidal, up to 1937, was Director of Air Commerce, in Washington, D. C., and Clark was in charge of the aircraft-procurement division of the Army during the first World War. Each has his own ideas of manufacture, but the basis is essentially the same.

Strips of plywood are treated with a thermosetting plastic, that is, a synthetic resin which, like Bakelite, softens when heat is first applied and then hardens into an insoluble and infusible mass with continued heating. The strips are then placed on a moid, and mold and plywood are alipped into a heavy rubberized bag. Inside a steam chamber, the pressure of the steam forces the bag against the plywood, while the heat softens and then hardens the plastic. The bag applies pressure equally on all parts of a curved surface, a thing virtually impossible to accomplish with a hydraulic press. Thus, in a single operation, a whole wing or fuselage can be turned out.

Such airplanes, "made in rubber bags," have many advantages. They are not affected by weather, funguses, oil, water, or They are free from internal strains. Because they have fewer parts, they are easier to repair. Another important feature of their design is the fact that the wing and fuselage surfaces are as smooth as glass. It takes more than forty horsepower just to pull the rivet heads on a modern all-metal akyliner through the air. Plastic construction would save power and increase speeds. Bombers could fly faster and training planes could be powered with smaller, more economical engines.

While mass production of such machines lies in the future, many authorities believe that the development of plastic planes will constitute one of the major advances of this war in which synthetic resins play such

varied roles.

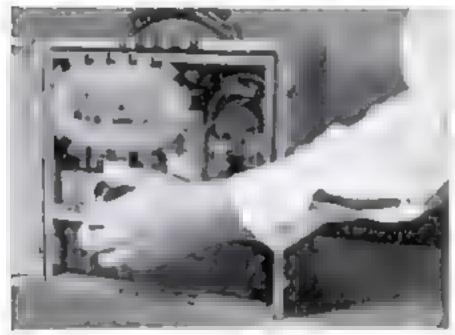
Bones Broken by Exertion

It is possible to break a bone by violent muscular exertion, according to Dr. Frank P. Strickler, of Louisville, Ky., who recently reported six cases of the kind in his own experience. However, Dr. Strickler adds, such accidents are extremely rare.

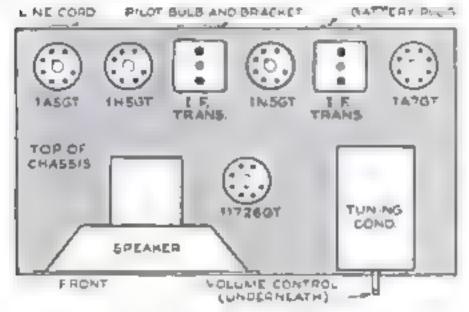
Please mention POPULAR SCIENCE when writing to advertisers.

Summer-Winter Radio

(Continued from page 193)



For autdoor use, the table model rests on a shelf in the larger cobinet, Bolow it is the battery pack



This top-chassis view shows how tubes are arranged

feeds into a five-inch permament-magnet speaker through a universal output transformer. As the reader follows the circuit diagram, he will see a fifth tube-the 117Z8GT—which serves as a rectifier, when the set is using A.C. house current, to supply the necessary direct current. The "A" current flows through a 2,500-ohm, 10-watt resistor and a 60-milliampere pilot bulb, which serves as a fuse to protect the filaments of the tubes, and does not light when the batteries are in use. Plate current is supplied through a 3,500-ohm, 1-watt resistor and two electrolytic condensers of 24 and 40 microfarads, respectively, and 150 volts each.

The two iron-core, intermediate-frequency transformers are peaked at 455 kilocycles and measure only 1¼" by 3¼". At the back of the 1-megohm volume control is a D.P., S.T. switch for turning off either battery or house current.

The 5" by 8" loop antenna behind the cabinet is held in place by three small screws. Notice that the speaker is attached directly to the front of the cabinet and that its frame is grounded to the chassis.

Please mention Popular Science when writing to advertisers.



WATERPROOF GLUE Its Cold-Setting Rot-Proof,

INVEST A QUARTER YOU'LL NEVER REGRET

IN ATRIAL CAN OF

WELDWOOD

Quick-Acting, Plastic

You've never known a glue like WELDWOOD for strength and everlasting results—a chemical miracle in this age of plastics.

WELDWOOD Plastic Resin. WATERPROOF GLUB makes a solid, permanent joint, downl, inley, mount, or seal stronger than the strongest material to which applied. WELDWOOD GLUE comes in powder form; mixes instantly with

know at own strength cold tap water, ready for use; no hanting, no watting, no bother, Joins may porous material to other porous or nonporous surfaces. Sets up a few hours after application.

The Glue of a Million Uses. Models, furniture, household repairs, patterns, bosts, sircraft, cabinet work, inlay, overlay, doweling, joining, mounting, makes workable wood putty.

UNITED STATES PLYWOOD CORP.

616 Wast 46th Street, New York

At your hardware dealer or send 25c, SPECIAL OFFER of LARGE CAN; and comprehensive GLUE MANUAL, check full of facts and ideas.





MODEL BUILDERS — ATTENTION!

Chempion has designed 3 spark plugs for model gas engines which give the same dependable performance as the regular spark plugs. Sillment sealed. Sillimanite insulator. Alloy peedlepoint electrodes for easy starting. One piece construction.

	_ V	V-2	V-3
liet	1/2"	%*	701
Thread	%' N	14, 15	14.12
Thrand Lungth	Via.	751	1/32
Weight Grane	4.	314	714

CHAMPION

SPARK PLUG CO. 901 Upton Ave. Toledo • Ohio

For \$" to 16" Motal Lathes. Build H Yourself,

At last, a precision grinder within your means. You save 2.3 by fasting our seem machined coatings on your own ights Mt H IN tending both interval and external grinding. According to 0.0025 Mirror frush easily obtained Grinds sufers patient to seek aga should be not not haber typical drailing to the patients, making restreet. Days governing drailing to the patients, continue abops. Write for FREM Dustrated folder and full information

Huran Machine & Tool Go., Dept. C-1, Yale, Mich.







Topi Matt, former Open Downbill "Champ" wing time and again on superb Northand skic. Tons picks Northands, the world a fin'st akis, to give him a smooth, winning flight. YOU can ski better on Northlands, too. Write today for FREE"How To Ski" Folder.

NORTHLAND SKI MFG. CO. World's Largest Shi Manufacturers 94 Merriam Park St Paul Minn.





who have his are Over 10 o'les & Statistics. The sales we were Warre to digi suplement Londonament per Montest Part Satisment and Self Starting, 199 up. 2 0 ml II.

THE THE THE PERSON OF THE PERS Write for Copyrights thingship

D W ONAN & SONS



WARREN, O P. O HOL

easiest way to paint!



Get a professional Smith with Incourer, an archivered, sever much perform to archivered, seconds and entrained quickly and est-ity Descend of abscuses apray-ing insecticides, moth-proofing, hymistrying, etc.

This guaranteed spray unit includes 110V At -[M' Mot it 6 ft of cord and plug, platon type coat from compressor leffic ent gun with the pt. glass container and it ft. of air hous.

Find \$1.00 today-per Postman belance of shapped prepaid if full price accompanies ander, MILLER-SIMONS, ONC., 2003 E. 61st Ct. Cisano, Mil.

Pays up to \$2 or \$3 an House

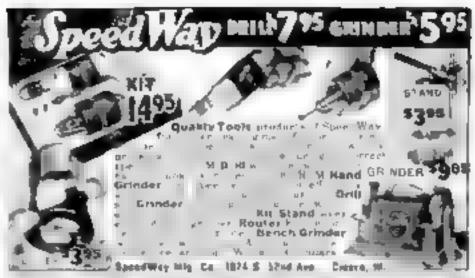
A POLEY Automatic Saw Filer files band circular and band saws better than the best hand filer (ash bust ness in canvassing as eyes, rain No experience needed Louis P Wadowick Ohio says 'I have filed 764 saws in space time and have carned \$850.00 in carpenter work due directly to my sow bling contacts. Soud coupon for PREE PLAN no obligation



Sond Free Plan on Saw Fling business

Name Address

FOLEY MFG CO., 116-1 Foley Bigg., Minnespolis,



IOOX TELESCOPE 100 Power Complete Less Kit

Make your own high powered telescope in one evening of easy work. All optical parts completely finished for 6 ft. long refracting telescope. Kit contains 1° diameter 75° P.L. ground and polished objective tens and 2 autronomical even ecca 50% and 100%. See the mountains and craters on the moon, the ringed planet Saturn the moons of Jup, or double stars etc Complete lens sit with full directions for mounting at the special price of only \$1 95 postould

BROWNSCOPE CO. Dept. 61A, 5 W. 27th St., New York TRAILER BUILDERS' GUIDE & CATALOG only 10c

Build a Trailer easily in space time with world's best line of tratter parts as ea batches Com-plete working h us brints only 5 to 1 niversal Draw Bar read by as a hed to any car SEND 10s Tillay F. R. (ATALID.

HAMMER BLOW TOOL COMPANY, Dopt. D. L. Wausau, Wie,

BE OUR REPRESENTATIVE IN YOUR TERRITORY

If you can spare an hour a day you can earn extra dollars taking care of Popular Science Monthly new and renewal subscriptions in your locality. Complete instrucand address to

EUGENE WATSON, Popular Science Mouthly, Dept. 11

Every Man Out of a Job

CAN NOW Go Into BUSINESS for HIMSELF!

Write to Popular Science Monthly about this plan which puts you into your own business. Be our representative. Get our wholesale rates and see how you can really make money taking subscriptions for Popular Science Monthly. More than half a million men now read this fast growing magazine. Show your copy to others and take orders. Every order gives you a real good profit. Some agents travel all over on their profits and pile up good bank accounts too. Write and get details of this good business plan. You will be surprised at the money you can make.

SIGN AND SEND THIS COUPON

Popular Science	Monthly
353 Fourth Avenue,	
Talk mar have t	

Dept. 11

Tell me how I can make money repre-scating Popular Science Monthly.

CITY	ET A TH	
ADDRESS	**************************************	
NAME	* *************************************	



Old Bill says . . .

WITH a couple of discarded 5" or 6" pulleys, machined as necessary, and parious lengths of pipe for sidepieces and crossbars, one can weld a good shop truck in no time at all.

To cut sheet aluminum, brass or copper without burrs, a hack saw or hand saw must have very sharp, accurately set teeth.

When drilling a deep hole, the least wear in the drill-press spindle will throw you off even if the drill point is perfectly ground. The safest procedure is to drill I" deep, line up a jig bashing, and sweat-solder it to the work.

You can generate a radius either way in a lathe by making an offset tool holder to replace the tool post and also using longer T-bolts for the compound to to insert springs under the unit.

When corrosion resistance is a factor, it is often more economical to make certain parts of stainless steel than to plate a cheaper material.

The radiator handwheel used in the modern hame is made of molded plastic and has many economical applications in the small machine shop.

To make a milling cutter perform better when it has a substantial number of teeth in proportion to its diameter, give the teeth a 2-deg. afternating cut, which will produce somewhat of a shearing action.

A universal vise in a shaper, plus the convenience of the latter's tool-past slide for angular settings, will give the machinest a combination that no regular milling machine can duplicate.

Metal spraying is not only most economical for rebuilding bearings, but it usually makes them twice as lough as they originally were.

In turning or boring monel, nichel, and inconel metals, it is better to take a deep cut and light feed than a light cut and heavy feed.





The Barron Multi-Purpose Planer
The Barron Multi-Purpose Planer is a sensetional, time-saving, versatile, low cost
shop tool. Fits any 14 h.p. or larger drill
press. Goaranteed pair to the by anrone.
Will not harm drill pross. Throme plated,
inherently belanced and fitted with Sepecial
H. Speed Moly Tuny streit brades with twin
cutting edges. Will even plane plywords,
minted and varnished surfaces. No other
tool provides so many practical case. Endured by drill press manufacturers, manquit training instructors, home workshop
enthus and, cabinet and parters guaren.
Enclusive design Put applied for Be convinced. Try it not yourself in your own
workshop or write for illustrated literature.

Money Back Free Trial Offer

Shipped parcel post prepaid on receipt of sheek or money order for \$7.50 or sent C.O.D. in U.S.A. Use it for five days and get PULL refund if not satisfied. YOU LISK NYTHING

BARRON TOOL CO., 329 Architects Bldg., Detroit, Wiek,

5-1#-1 ROTARY WOOD PLANER

Make This a Real Christmas for Yourself and Friends WITH CLEVELAND MODELS

Record-Breaking PLAYBOY SENTOR, Span 10"
The gas model that broke world's record being in unworld Class C. (template Kit GP-8017
\$2.00
(attorpt pawer unit) 5386 Ø

PLAYEDY Mr. Span of Class B. Comptete Rit CP-2006 (encept 5-280



CLAYELAND MODEL & SUPPLY CO., MC.,

BANT PLAYEOT. Room 22". Clade A Complete Kit GP 5000 B 1 00 (except power sait) 84" Compan Searing Gilder. Fas by built Complete Mit \$100

COMPLETE

Write for Free Folder

or See Your Decler.

his Catalog of Gas & Rubber Medel Atrolanes Race Cata Ships, RR's etc Send name seldress and only de for your copy (None (rec)

"Ta propide p about through the year"

469646 Larvis Suc.,

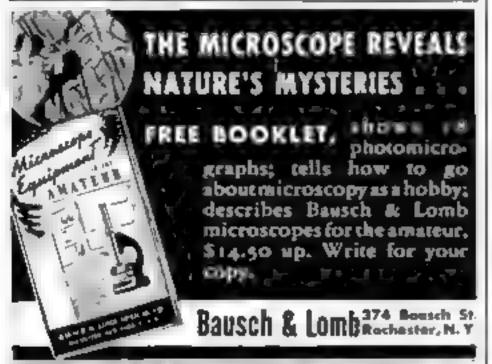
Gitt! Christmas Extraordinary

DAYLIGHT FIXTURE Frevides

Takes two 20-watt tubes. equivalent of 130 wall locandes-centiamp Consumes 30 walls in current! Stard by construct-ed. Wired for 110 123 volts.

80 eyels a ternating current.
No instantion required.
Screw out butb, plug to funrescent light PRICE complets with tubes \$9.75 FOR.
New York, Entra buibs \$1.25
eath, Buibs burn over 1,500 hours. TM PORTANT dering specify alar of fitter flee-idential usualty 4 commercial 4 from 1 by tonney order bank draft, or certified theck, 30 day meson back guerostee

BRAUN ELECTRIC MFG. CO., 118 East 28th St., NYC-Dopt. 5-2 Distributors wanted hig money NeW selling Sucrescent facures to humos offices retail shops factories ste



GRANDFATHER CLOCK

SEND 25 clor SIMPLE SHOP TESTED COPYRIGHTED BY LEPRINT The Sandy & Sens by First King way as Expressed have DIME by car 19 Non and the sp 110 W Book by a ne many the transport of Westmander Tube Chime - left and on any Westminister Tube chime - off and on style one to able to a complete the substitution ontal grandfather area Build now and save half NUEMPEL CHIME CLOCK CO., Bldg. A-27 Guttenberg, Iowa.



WHEN a toy transformer of the kind used to operate model railroads gets out of order, the trouble is usually caused by a broken connection. Plug in the transformer and hold it close to your ear. If no hum is heard, the break is in the 110-volt wiring, and the trouble can often be found at the point where the cord passes through the porcelain bushing in the case. Generally, the copper strands of the wire break, leaving the insulation intact, so no defect is visible. This can be repaired by removing the cover of the transformer, cutting out the defective section of wire, and joining the ends together. If possible, solder the new joint and insulate it carefully with a layer of rubber tape, then friction tape. Some transformers are filled with pitch and in repairing the wires it is necessary to dig them out with a penknife, taking care not to break them.

If the transformer hums but no current is obtained from the terminals, the fault will be found in one of the low-tension wires leading to the various binding posts or the speed-control switch.

A transformer that has been continuously short-circuited will burn out. This condition can be detected by a burnt smell, and charred wiring inside. There is no way of repairing a burned-out unit except to rewind the coils, and in nearly every case this is not worth while.—H.V.L.

Printer's Brass Rule Makes Accurate Straightedge

HAVING occasion to rule a number of long lines. I tried to buy a straightedge that was straight. I looked at scores of brass-edged rulers 18" long, and the best of them had a bow of over 1/16". The only satisfactory ones I could find were steel straightedges at artists' and draftsmen's supply stores, but these cost several dollars each-more than I wanted to pay.

Finally I went to a printers' supply company and bought a 24" length of one-point brass rule on a two-point base. It is about as straight as one could ask, yet it cost only a few cents. Being on a two-point base, the edge is slightly raised from the paper, which prevents ink smears. If desired, the rule could be cemented to a piece of printer's "regiet"—a wooden strip less than type high—which will raise the edge about 1/4" off the paper. The strip protects the rule and makes it easier to handle.—LEE UNDEBHILL.

Please mention Portilar Science when writing to advertisers.

Th1 # Dn # GQAQ-BYT-XODQ



Home Craftsmen, Schools, Hobbyists



in your own workshop allows you to design and build your own GABOLINE ENGINES, STEAM ENGINES, STAT-UARY, ART OBJECTS, SPECIAL TOOLS, NEW INVENTIONS, ETC. You can also make forgings and case harden steel. Your shop is not complete with-out a FOUNDRYETTE, Three sizes are available capable of making bronze castings of 1%, 3, and 6 pounds weight. aluminum, copper, brass, etc. \$13.50, \$19.00, \$27.50, I.o.b. Kansas City. Domestic gas supply and 110 volt 60 cycle energy required for operation. Write for circular,

KANSAS CITY SPECIALTIES CO. Box 6022, Dept. 5-21 Kansas City, Mo.

KINKADE GARDEN TRACTOR

and Power Lawnmower A Practical Power Plow and Cultivator for Gardeners, Suburbanites, Florists. Truckers, Nurserymen, Fruit Growers y

Low Prices - Easy Terms American Farm Machine Co. 1072 33rd Av. SE. Minneapolis, Minn.



rinting Business

Cards, Tickets, Stationery, etc. Good profit in space time-print four own greeting cards, movie titles, church work, etc. Save money. Easy rules supplied. Junior Press \$8, Senior Outlits \$18 up. Have home shop. Haised printing like engra-ing too, Sold direct from factory enty, Write for free catalog and all details. MELSEY, INC. X-33, MERIDEN, CONN.



MAKE MONEY! Wood is valuable. Does more than 10 men. Easily operated. Falls treve-saws limbs, the 5-bp. engine for other work. Wille for FREE Book.

OTTAWA MFG. CO. 1601 Wood St., Ottown, Kares.





Go into business—Open a welding shop now. AGENTS Make big profits selling to garages, factories, janitors and machine shops, Write today for our 10-DAY TRIAL OFFER, DYNAMIC WELDER COMPANY, 2226-PC SILVERTON ROAD, CHICAGO, ILLINOIS

BARGAINS FOR

Craftsmen! Get This Big Book of Rore Woods, Venters, Inlays, Plywoods, Jig Saw Patterns, Tools and Supplies



Just out Big new 1941
Bargain Catalog No. 14 Bereit F. Seet
for Woodworkers. Send PRESIDENT for yours TODAY, 146 pages-20 col-or pages including rare and domestic woods in FULL NATURAL COLORS. Every page crammed with fascinating projects—new inlay methods—shortcut wood-finishing processes - hun-dreds of fascinating scroll saw projects for making book ends, tables, lamps, furniture and novelties.

If It's Wood-I Have It Big bargains in rare woods from Asia, Africa, and the Indies, NEW LOW PRICES. Complete stock of American woods, veneers, inleys, ornaments, hard-to-get hardware items, tools, etc. immediate shipment at real etc. Immediate shipment at real money-saving prices. Get this book TODAY. Send only 10c-coin or stamps-refundable on first order. CRAFTAMAN WOOD SERVICE CO. 3729 S. Mary St., Dopt. A-B. Chicago, III.

Harold F. Hant, President, CRAFTSMAN WOOD SERVICE CO. 2729 S. Mary St., Dept. A.S. Chitago, III. Enclosed find 10c (refundable on my first order) for which please send me your big new 1941 Catalog No. 14.



148

PAGES

BIG BARGAINS IN-

Rare Woods . Inlays Veneers - Bandings

Plywoods - Hardware

lig Saw Patterns

Ornaments - Tools All Kinds Supplies

TRAILER PARTS CATALOG

We'll sere you money on akins, springs, wheels, couplers, windows, sinks, water sumps, brakes, refrigerators, leds, large, incide and set, if large, furniture, acks everything, Special discount to mirs, KATIONAL TRANSES EQUIPMENT CO. Sucressors to Kar-A-Van Industries, Inc. Copt. 3-5-714 W. Wisconsin Ave., Miscousine, Wis.

EASILY AND EXPERT PAINTED WITH LETTER PATTERNS SIZES AND STYLES S JOHN F. RAHN CHICAGO, ILL.

374 Territories Open Local Manufacturers

Wanted-374 exclusive manufacturers to make Brikerete—the modern, colorful, improved de-sign—air-insulated building unit Better than brick, yet it cuts cont to level of frame. Ideal for all types of buildings. Permanent, light-weight, easy to hy, Meeta today's low cost housing program.



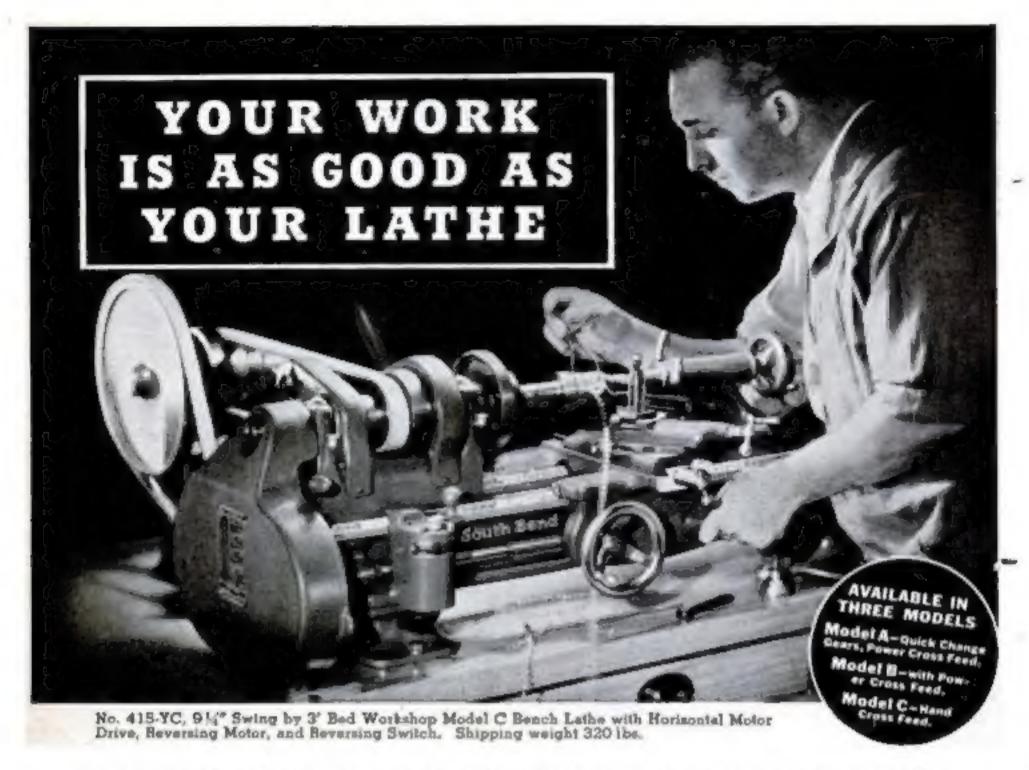
Modern Building Material



Brikerete is easy to make with local low cost materials and labor. Large and growing market. Big profit up to 150%. Liberal territory granted, protected by franchise. Life-time opportunity for men of modest expital. We furnish all equipment. Easyto-pay terms. Only modest investment. Write today for The Brikerete Book-free.

BRINCRETE ASSOCIATES, INC., 4675 Division Ave. \$ Grand Rapids, Michigan

California comet



SOUTH BEND ACCURACY IS ESSENTIAL

THE quality of work in any shop depends on the accuracy and efficiency of the shop machinery. Shops having a reputation for fine workmanship use the best machinery available.

South Bend Lather are used for precision tool and instrument work by the Sperry Gyroscope Co., Lyman Gunsight Co., and Bausch & Lomb Optical Co. Hundreds of other nationally known manufacturers depend on South Bend Lather for the most exacting classes of machine work.

You can depend on a South Bend Lathe to do accurate work and retain its accuracy through years of service. Large micrometer dials are easy to read; convenient controls make the lathe easy to operate; hand-scraped V-ways on the semi-steel bed assure perfect alignment; precision machine cut gears provide smooth, steady transmission of power to the carriage.

SOUTH BEND LATHE WORKS

FIVE SIZES OF SOUTH BEND LATHES. Manufactured in 9", 10", 13", 14 1/4", and 16" Swing, in 3' to 12" bed lengths, in individual Motor Drive and Countershaft Drive, in Quick Change Gear and Standard Change Gear. Catalog No. 100 illustrates and describes all sizes and types. Get a copy from your dealer or write direct to the Company.

ON DISPLAY IN ALL PRINCIPAL CITIES

Baltimore, Md.—Carey Machinery & Supply Company Boston, Mass.—South Bend Lathe Works* Buffalo, New York—R. C. Neal Company, Incorporated Chicago, 111.—South Bend Lathe Works† Cleveland, Ohio — Reynolds Machinery Company Detroit, Michigan — Lee Machinery Company Los Angeles, Cal. — Eccles & Davies Machinery Co. Milwaukee, Wis. — W. A. Voell Machinery Company Newark, N. J.—J. R. Edwards Machinery Company Newark, N. J.—J. R. Edwards Machinery Company New York, N. Y.—A. C. Colby Machinery Company

Philadelphia, Pennsylvania — W. B. Rapp, Machinery Portland, Oregon — Portland Machinery Company Providence, Rhode Island—George T. Reynolds & Son Rockford, New York — Odden R. Adams Rockford, Illinois—Factory Supplies Company Seattle, Weshington — Star Machinery Company Sen Francisco, Cal. — Moore Machinery Company St. Louis, Mo.—Colcord-Wright Machine & Supply Co. St. Paul, Minn.—Robinson, Cary and Sands Company Tolado, Ohio — Eno Tool and Supply Company

*Boston Sales Office, 67 Broadway, Kendall Square, Cambridge, Mass.; Telephone Trowbridge 6369, †Chicago Sales Office, Room 308 Machinery Sales Building; Telephone State 7283.

SOUTH BEND Precision LATHES

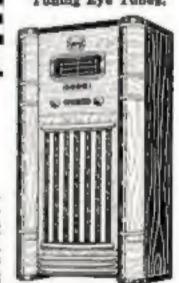


they represent today's outstanding values! If you get a big "kick" out of owning a super powerful radio that

TO

and world-ranging ability of these ouper Midwests. Just imagine being able to pull in world-distant broadcasts from the capitals of Europe-to hear history in the making before it

Just think! Here's a super powerful 15-tube radio-complete in cabinet—at a price you would ordinarily pay for a 7 or 8-tube set. Never before have you been offered so much radio for so little money !



Crear pared received

Now, you can not only eave up to 50% by buying direct from the Midwest factory—but, Midwest allows you up to \$25 on your old radio on many models shown in the big, FREE Midwest Catalog. Send for this catalog and see for yourself that it actually brings the Midwest factory to you, that it pictures and dramatizes many beautiful, 1941 factory-to-you radio values—from 6 to 18 tubes—up to 5 wave bands —including Automatic Record-Changing

Radio-Phonographs, Home Recorders, etc.

TRADE-IN ALLOWANCE*

ON YOUR OLD RADIO

(Model Z-18 shown at latt)

FILL IN COUPON AND MAIL TODAY OR JUST SEND YOUR NAME AND ADDRESS ON IS POSTCARD





MANUFACTURERS OF QUALITY RADIOS SINCE 1820

RADIO CATALOG

Our famous 30-day proveit-yourself - plan fully protects you and enables Jon to prove Midwest's super performance in the privacy of your home. No obligation.

MAIL COUPON FOR FREE CATALOG

Midwell Radio Corporation Cincinnal, Ohio, U.S. A. Dept. 59-HH

Send me your new FREE Catalog, complete details of your liberal 30-day Trial offer and factory-to-you prices. Name ...

Osor-Agents Make Easy Extra Money. Check here () for details.

